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DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE, CIVIL ENGINEERING, THE ARTS AND MANUFACTURES, AND THE RECORDING OF AMERICAN AND OTHER PATENTED INVENTIONS.

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JOURNAL

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THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

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PROMOTION OF THE MECHANIC ARTS.

JANUARY, 1853.

CIVIL ENGINEERING.

On the Expansive Working of Steam in Locomotives. By DANIEL KINNEAR CLARK, C. E.—(*With a Plate.*)*

[Abstract of a Paper read at the Institution of Mechanical Engineers.]

In locomotives, the adoption of a low standard of boiler pressure is the first obstacle in the way of carrying out the expansive working of steam, as the more expansively the steam is worked, the less is the work done by the engine. The second obstacle is, in many locomotives, the exposure of the cylinders, by which the steam within is partially condensed. Moreover, the proportion of steam so condensed increases with the degree of expansion, in a very formidable ratio, which will be afterwards submitted to examination.

The object of this paper is to show at what rate in practice the efficiency of steam is increased by expansive working in locomotives with the best existing arrangements of cylinders, valves, and valve-gear, and to point out the conditions on which expansive action may be most successfully carried out.

I.—*Of the Action and Capabilities of the Link-Motion.*—The action of the valves in the "distribution" of the steam (a term borrowed from the French) is regulated by three elements, the lap, the lead, and the travel.

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* From the London Civil Engineer and Architect's Journal, September, 1852.

When these are given, the point of the stroke of the piston at which the steam is admitted to the cylinder, cut off, exhausted, and compressed or shut up, are all deducible by model, by diagram, or by calculation. This can be done, whether the valve derives its motion from a single eccentric, or from a link-motion, as the motion of the valve is virtually the same in both cases. The way in which the valve is caused to cut off or suppress the steam earlier by the link-motion, is by *shortening the travel of the valve;* this is accomplished by means of the reversing gear, in such a manner that whatever be the reduction of travel communicated to the valve, the lead is always at least the same as in full gear, and with the shifting-link is rather increased.

In working out the four changes in the distribution of the steam, already enumerated, which regulate the movements of the steam, the action of the link-motion is such that, 1st, the sooner the steam is cut off, the sooner it is exhausted, the sooner the port is closed for exhaustion, and the sooner the port is opened for the admission of steam.

2d, That though every change is made earlier—as measured in parts of the stroke—there is less difference in the position of the points of exhaust, compression, and admission, than in that of the cutting off. Consequently, the shorter the admission, the longer is the expansion, as the exhaust point does not recede so much as the point of cutting off.

3d, That by the shifting link-motion, the steam may be cut off at from $\frac{1}{6}$th to $\frac{1}{7}$th of the stroke.

4th, That though the exhaust takes place earlier for every increase of expansion, it does not in any case take place within the first half of the stroke. For mid-gear it occurs in fact at 54 per cent. of the stroke; and the steam is expanded into 3½ times the length of stroke at which it is cut off.

5th, That the period of compression, increasing as the admission is reduced, amounts to about one-half stroke in mid-gear.

6th, That the pre-admission of the steam, not above 1 per cent. of the stroke in full gear, reaches about 10 per cent. in mid-gear.

These results prove that the link-motion is capable of cutting off steam as early in the course of the stroke as can ever be advisable in practice.

It has been seen that the earlier the steam is cut off, the *earlier also it is exhausted;* until in mid-gear it may be released at half stroke. This has been deemed a serious objection to the use of link-motions for high expansion, as it is supposed to lead to a serious loss of expansive action, by exhausting prematurely. This loss is, however, a mere trifle in practice. The escape of the steam is by no means instantaneous, as is easily proved by the diagrams in fig. 1 (Plate I.), taken by the writer from the *Caledonia,* passenger engine, by means of M'Naught's Indicator, at speeds of 1 and 2 miles per hour. The numbers in the diagrams indicate the number of the sector notches to which the reversing lever was placed, while the diagrams were described. Referring to No. 1, taken under full gear, the steam is shown to be admitted to the cylinder a little before the beginning of the stroke, at A. From B to C the steam is admitted, at C shut off, expanded to D, and thence exhausted to E, the end of the stroke, whence it continues to be exhausted till the point F in the return stroke, where the exhaust port is closed. Now, the exhaust line, D E, shows that nearly all the period of exhaust for the steam stroke is employed for the complete evacuation of the steam. And if this be the case for speeds of 1 and 2 miles an hour, it is much more so for the regular working speeds of trains. To select from a very admirable series of Indicator Diagrams, with copies of which the writer has been favored by Mr. Daniel Gooch, by whom they were taken from the cylinder of the *Great Britain*, locomotive, on the Great Western Railway, the figs. 4 and 5 contain diagrams taken at 17 and 55 miles per hour respectively, under the 1st, 3d, and 5th notches of the sector. The following are the conditions of the valve motion of this engine, when the diagrams were taken:

State of the Valves of the "Great Britain" Locomotive, G. W. R.

Cylinder, 18 × 24 inches; wheel, 8 feet; lap, 1¼ inch; constant lead, ⅜-inch; travel in full gear, 4¾ inches; blast orifice, 5½ inches diameter.

No. of Notch.	Position of Points of Distribution.			Period of exhaust during steam stroke.
	Cutting off.	Exhaust.	Compression.	
	Inches.	Inches.	Inches.	Inches.
1	16	21⅜	3	2⅝
3	11¾	19¾	5	4¼
5	7	17⅜	7½	6⅝

On the diagrams the points of cutting off and exhaust are marked, and the steam line falls only very gradually during the period of exhaust, and especially at the high speeds. The expansion curves are shown by dotted lines, A, B, C, figs. 4 and 5, continued to the end of the stroke. These are easily calculated in terms of the relative volumes of steam, from the pressures indicated at the points of exhaust, and are such as would have been described had the exhaust been delayed till the end of the stroke. The shaded areas, A, B, C, inclosed between these dotted curves and the curves actually described, express the *power lost* by exhausting the steam *before the stroke is completed*. Averaging them for the whole stroke, they are as follows:

	Low Speeds.	High Speeds.
1st Notch,	⅞ lb. per in. loss.	1 lb. per in. loss.
3d "	2¼ lb. "	1 lb. "
5th "	3⅓ lb. "	⅜ lb. "

The losses at high speeds are very small, merely nominal; and curiously enough, the loss by the *earlier* exhaust of the 5th notch is actually less than that under the 1st notch. The losses are of course greater at the low speeds; but even then, in the 1st notch, which is the only notch employed at very low speeds, the loss does not amount to 1 lb. per inch. The 3d and 5th notches are employed only at speeds much above 17 miles per hour, and the loss by them is of no practical moment.

Upon the whole, it follows that the possible *loss by the early exhaust* yielded by the link-motion is of *no importance*. On the contrary, it can be proved to be *beneficial*, as an early exhaust is at high speeds essential to a perfect exhaust during the return-stroke. It plainly appears, therefore, that with the existing arrangements of locomotives, any attempts to eke out the power of the steam-line, by prolonging the expansion materially beyond what is accomplished by an ordinary valve and link-motion, are not only useless, but highly prejudicial.

Another objection to the link-motion is, that the steam is injuriously *wire-drawn* by it when under great expansion. Hence the numerous attempts to supersede the link by the employment of a separate expansion valve. The diagrams, fig. 5, may be referred to as examples of wire-drawing by the link. They were taken nearly consecutively with one opening of the regulator; and it is clear that the steam attained fully as high a pressure in the cylinder under the 5th notch as under the 1st. The pressure falls considerably towards the point of cutting off, but from the form of the steam-line, it is plain that very little additional steam is admitted for an inch or two before the cutting-off actually takes place. The most of the steam is admitted at the higher pressure, and in fact a partial expansion of the steam already admitted takes place for some distance before the expansion nominally begins. Thus the *wire-drawing* is, to a great extent, equivalent to an *earlier cutting-off*, and a greater degree of expansion. The whole possible loss by wire-drawing is comprised within the dotted line D, added to the diagram, which is merely an extension of the expansion curve to meet the steam line, drawn horizontally to represent a free admission up to an imaginary point, D, of cutting off, 5 inches from the beginning of the stroke. This shaded area, D, amounts exactly to a mean loss upon the whole stroke of *one pound per square inch*, by *wire-drawing*, under high expansion. For the 1st and 3d notches, the amount of loss by wire-drawing must obviously be still less; and, in short, the objection of *wire-drawing by the link-motion*, when of liberal proportions, is of *no practical weight*.

Another objection to the link-motion, and apparently the most formidable one, is the large fraction of power neutralized by the *compression* of the exhaust steam, and which increases with the degree of expansion. Compression, however, involves no loss of efficiency; for as by compression a quantity of steam is incidentally reserved and raised to a higher pressure, it gives out the power so expended in compressing it, during the next steam stroke, just as a compressed spring would do in the recoil. But, apart from this general argument, the actual efficiency of the steam in the cylinder, with and without compression, may be exactly estimated. The most direct method of doing so is, to find the quantities of water consumed as steam for one stroke, under the two conditions, and to compare them with the relative effective mean pressures. It will suffice to analyze, as an example, the high speed diagram, fig. 5, under the 5th notch, No. 5. The volume of steam admitted is measured by the product of the area of the piston, (254·47 in.,) and the period of admission, *plus* the total clearance in the cylinder and steam passage; the clearance being measured for simplicity in inches of stroke, we have $7 + 1{\cdot}8 = 8{\cdot}8$ inches, for the total volume admitted. The pressure of the steam when cut off is 65 lbs., for which the relative volume of water is 359. Therefore, the volume of water as steam, or the water equivalent of the steam admitted, is

$$\frac{254{\cdot}47 \times 8{\cdot}8}{359} = 6{\cdot}24 \text{ cubic inches.}$$

From this is to be deducted the quantity of steam reserved by compression; the volume so reserved is measured by the period of compression, *plus* the clearance $(7{\cdot}5 + 1{\cdot}8 = 9{\cdot}3)$, and the pressure at the point of compression is 8 lbs., for which the relative volume is 1125. Then the water equivalent of the reserved steam is—

$$\frac{254{\cdot}47 \times 9{\cdot}3}{1125} = 2{\cdot}10 \text{ cubic inches;}$$

subtracting, there remains $6{\cdot}24 - 2{\cdot}10 = 4{\cdot}14$ cubic inches of water as steam, actually expended for one stroke of the piston.

Were there to be no reservation of exhaust steam by foreclosing the exhaust port, the whole area of resistance by compression would be removed, and there would be a reserve of steam of atmospheric pressure equal in volume to the clearance only. The relative volume of atmospheric steam is 1669, and the water equivalent of the reserve would be

$$\frac{254{\cdot}47 \times 1{\cdot}8}{1669} = 0{\cdot}27 \text{ cubic inches;}$$

the expenditure per stroke would be $6{\cdot}24 - 0{\cdot}27 = 5{\cdot}97$ inches of water.

	Per Inch.
Now the positive mean pressure during the steam stroke, as indicated, is	40·9 lbs.
And the mean resistance by compression is . .	11·5 "
Thus the effective mean pressure is . . .	29·4 "

This effective mean pressure of 29·4 lbs. is maintained by a consumption of 4·14 inches of water per stroke; and it has just been found that with the compression removed, the positive mean pressure of 40·9 lbs. per inch would be maintained by a consumption of 5·97 inches of water per stroke. The effective pressure created per cubic inch of water is therefore,

In actual practice . . $\frac{29{\cdot}4}{4{\cdot}14} = 7{\cdot}1$ lbs.

And would be by removing compression $\frac{40{\cdot}9}{5{\cdot}97} = 6{\cdot}9$ lbs.

These quantities are expressions of the relative efficiency of steam employed with and without compression; they are virtually identical, and show that the resistance by compression in the cylinder, due to the action of the link-motion, does not in the slightest degree impair the efficiency of the steam.

The last objection to the use of the link, requiring notice, is that at *high speeds* considerable *back exhaust pressure* is created. The amount of this is very various, and it depends also on circumstances for which the link-motion is not responsible; such as a deficiency of inside lead (which is regulated by the lap), small ports, a small blast-orifice, and imperfect protection of the cylinder. It suffices on the present occasion to point to what can be done by superior arrangements, as exemplified in the diagram, fig. 5, taken from the *Great Britain.* The cylinders of this engine are in a manner suspended in the smoke box, and thoroughly protected; the steam ways are very large, 13×2 inches, being in area about $\frac{1}{10}$th of the cylinder; the exhaust passage is very direct; and the blast-orifice is $5\frac{1}{2}$ inches diameter, or about $\frac{1}{11}$th of the area of cylinder. As a whole, these proportions are superior to those of any other engines with which the writer is acquainted; and the diagrams prove that the per centages of back exhaust pressure, in terms of the positive mean pressure, at 55 miles per hour, are—

For the 1st notch, ...	$8\frac{3}{8}$ per cent.
For the 3d notch, ...	$5\frac{3}{4}$ per cent.
For the 5th notch, ...	nothing.

Better results than these should not in practice be required, for when locomotives are adapted to their work, and running at high speeds, they ought not to require an admission of steam above half stroke. However, the area of blast-orifice rules the back exhaust pressure; and, when the cylinder is duly proportioned to the boiler, it is quite practicable, by a few modifications in detail, still further to increase the orifice, sufficiently to banish all traces of back pressure of exhaust at all practicable speeds.

II.—*Of the Rate of Efficiency of Steam worked Expansively in the Locomotive, by the Link-Motion.*—To determine this ratio experimentally, under the actual circumstances of clearance, wire-drawing, and back pressure, the writer has analyzed twenty-six of the indicator diagrams from the *Great Britain*, already referred to, taken at speeds of 15 to 56 miles per hour, of which the figures are examples. The following table contains in the first nine columns an analysis of these diagrams; the effective horse powers, column 10, are estimated in terms of the diameter and stroke of cylinder, the diameter of the wheel, and the effective mean pressures in the 9th column. The water equivalents, columns 11, 12, and 13, are estimated from the indicated pressures and the period of the distribution for each notch, in the way already exemplified. The expenditure of steam per hour, column 14, is deduced from column 13, in terms of the speed, the cylinder, and the wheel; and, dividing that by the effective horse power, we have the contents of column 15 in inches, and of column 16 in pounds. Column 17 contains the coke consumed per horse power per hour, deduced for the several diagrams from the consumption of water, column 16, allowing 1 lb. of coke to evaporate 8 lbs. of water.

Referring to the contents of the last two columns of this table, it is obvious that the consumption of water as steam, or of coke, for a given amount of work done, becomes less the more expansively the steam is

Results from Indicator Diagrams, taken from the Great Britain, Locomotive, G. W. R., in 1850.

No. of Diagram.	Speed of Engine in miles per hour.	Indicated steam pressure in cylinder in lbs. per square inch.							Effective horse power indicated.	Water equivalents.						Coke consumed per effective H. P. pr hour; allowing 1 lb. for 8lb. of water.
		Maximum pressure during admission.	Positive mean pressure.	Back pressures.				Effective mean pressure.		Total Admitted for one stroke, meas'd. from diag'm.	Reserved by Compression	Actually expended during 1 steam stroke.	Actually expended per hour.	Actually expended per effective horse power per hour.		
				Exhaust.	Compression	Sum of back pressures.										
						Pressure.	Per cent of positive steam pressure									
	Miles.	lbs.	lbs.	lbs.	lbs.	lbs.	per cent.	lbs.	h. p.	cu. in.	cu. in.	cu. in.	cu. ft.	cu in.	lbs.	lbs.
1	15	70	63·8	1·6	2·4	4·0	6·1	59·8	190	13·32	1·00	12 53	80·83	817	29·5	3·60
2	17	88	80·3	0·6	1·9	2·5	3·0	77·5	284	15·89	0 82	15·07	124·53	758	27·4	3·42
3	21	95	86·2	1·2	3·0	4·2	4·7	82·0	372	16·71	1·09	15·62	159·45	741	26·8	3·35
4	24	85	76·7	0·9	1·6	2·5	3·1	74·2	384	15·30	0 82	14·48	168·95	760	27 5	3·44
5	27	80	70·6	1·5	2·2	3·7	5·3	66·9	389	13·89	0·91	12·98	170·57	757	27·4	3·42
6	31	90	79·6	1·7	3·7	5·4	6·7	74·2	497	15·62	1·13	14·49	218·35	759	27·4	3·42
7	31	80	73·2	2·9	2·2	5·1	6·9	68·1	456	14·76	1·00	13·76	207·35	786	28·4	3·55
8	49	60	51·4	3·6	4·4	8·0	15·5	43·4	459	10·73	1·34	9·39	223·60	842	30·4	3 80
9	54	89	80·4	6·8	6·0	12·8	15·8	67·6	763	15·62	1 56	14·06	369·07	836	30·2	3·77
1st Notch—Means		82.						68·2							28.3	3·54
10	17	88	69·9	0·0	3·8	3·8	5 4	60·1	242	12·19	1·10	11·09	91 65	654	23·7	2·96
11	18	70	55·3	0·8	4·5	5·3	9 4	50·0	194	10·33	1·35	8·98	78·57	700	25·3	3·16
12	21	92	72·3	0 0	4·2	4 2	5 7	68·1	309	12·50	1·16	11 34	115·78	647	23·4	2·92
13	26	72	57·1	0·0	4 9	4·9	8 5	52·2	293	10·55	1·41	9 14	115·52	681	24·6	3 07
14	31	79	60·3	1·2	6·0	7·2	11·9	53·1	356	10 87	1·48	9 39	141·50	687	24·8	3·10
15	32	86	64·4	0 8	4·9	5·7	8·4	58·7	407	11·33	1·29	10·04	156.20	663	24·0	3·00
16	40	76	55·7	0·4	4·7	5·1	9·1	50·6	437	9·78	1 35	8·43	163 87	648	23·4	2·92
17	51	70	49·1	2 0	6·2	8·2	16·6	40·9	450	8·65	1·54	7·11	176·30	677	24·5	3 06
18	55	84	62·0	3·6	7·6	11·2	18·0	50·8	603	10·54	1·66	8·88	237·42	680	24·6	3·07
3rd Notch—Means		80						54·5							24·3	3·03
19	17	89	53·2	0·0	9·6	9·6	18·0	43·5	159	7·90	1·85	6 05	50 00	543	19 6	2 45
20	18	70	42·1	0·5	6·6	7·1	16·7	35·0	136	6·59	1·70	4·83	42 26	537	19 4	2 42
21	21	93	56·5	0·0	6·3	6·3	11·1	50·2	228	8·20	1·42	6·78	69 71	525	18·9	2 36
22	28	74	41·8	0·4	6·2	6·6	15·7	35·2	213	6·87	1·68	5·19	70·64	537	20 7	2·59
23	31	83	40 5	0·0	7 4	7 4	15·5	39·1	262	7·29	1·59	5 70	85·89	566	20 5	2 56
24	36	80	39·0	0·0	8·5	8·5	21·1	30·5	237	6·08	1·85	4 23	74 02	540	19 5	2·44
25	50	77	34·7	0·5	8·0	8·5	24·4	26·2	263	5·52	1 70	3·76	91 39	600	21 7	2 71
26	66	90	40·9	0·0	11·5	11·5	28·1	19·4	353	6 24	2·10	4 14	113 20	554	20 1	2 51
5th Notch—Means,		82						36·1							20 1	2·61
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

worked; and the means of the several quantities for the notches separately are as follows:

Consumption per Horse Power per Hour.

For the 1st notch, 28·3 lbs. water, or 3·54 lbs. coke.
" 3d " 24·3 " " or 3·03 " "
" 5th " 20·1 " " or 2·51 " "

As the results under each notch vary very little, the means above stated may be adopted for all practical speeds without material error. From these mean quantities the following rule is derived:

Rule I.—*To find the consumption of Water as Steam per horse power per hour, for a given period of admission.* Multiply the part of the stroke in inches during which the steam is admitted by 22, and divide by the length of stroke in inches, and add 14 to the quotient. The sum is the required consumption in pounds. Let L=length of stroke, S=the period of admission of steam, and W=the consumption of water in pounds per horse power per hour; then

$$W=22\frac{S}{L}+14 \quad . \quad . \quad . \quad . \qquad (1.)$$

Allowing 8 lbs. of water to be evaporated by 1 lb. of coke, we have the following rule for the consumption of coke:

Rule II.—*To find the consumption of Coke per horse power per hour, for a given period of admission.* Multiply the period of admission in inches by 2·75, and divide by the length of stroke in inches, and add 1·75 to the quotient. The sum is the consumption in pounds per horse power per hour. Making C the consumption of coke, we have

$$C=2{\cdot}75\frac{S}{L}+1{\cdot}75 \quad . \quad . \qquad (2.)$$

These rules may be employed with safety for all periods of admission between 10 and 75 per cent. of the stroke, which are the utmost limits worth regarding in the locomotive engine. They are applicable also for maximum pressures during admission, ranging between 60 lbs. and 120 lbs., though based on results from steam of 80 lbs. to 84 lbs. maximum pressure. For extreme pressures, the results by the rule are slightly too small in the case of lower pressures, and rather greater for the higher; these divergences being due to the constant deduction of 15 lbs. for atmospheric resistance from the total pressure. It is presumed that engineers will not return to the error of low pressures in locomotives, and that high pressures will be cultivated. For pressures above 80 lbs., the rules are perfectly safe, as they err rather by excess on the safe side. The following table is worked out by Rule I., to show the efficiency of steam by expansion in the locomotive cylinder, under good conditions in actual practice. The 4th column contains the theoretical maximum relative efficiency of steam, expanding to the end of the stroke, according to the law of Boyle, with a perfect vacuum behind the piston, and without clearance, back pressure, or compression; extracted from the ordinary tables on the

Indicat

Fig.1. *Slow Speed.* *Caledo*

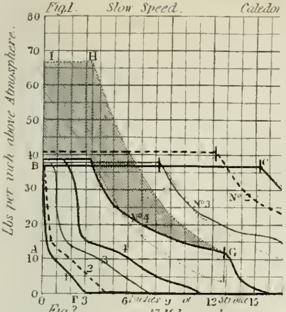


Fig 3. *17 Miles per hour*

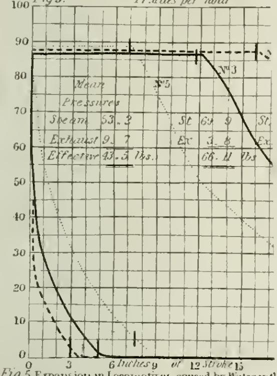
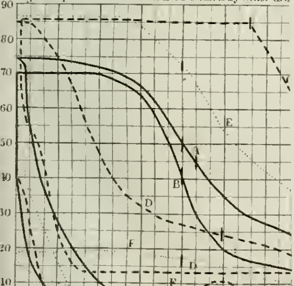


Fig 5. Expansion in Locomotives caused by Water in th



Indicator Diagrams from Locomotive Engines

Fig.1. Slow Speed. Caledonian Engine No 13

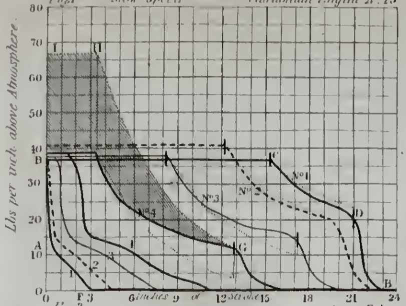
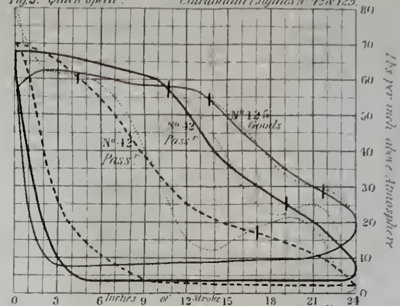


Fig.3. Quick Speed. Caledonian Engines No 42 & 125.



Great Britain Locomotive

Fig.3. 17 Miles per hour

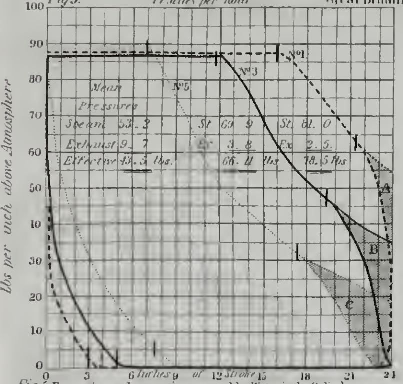


Fig.4. 55 miles per hour

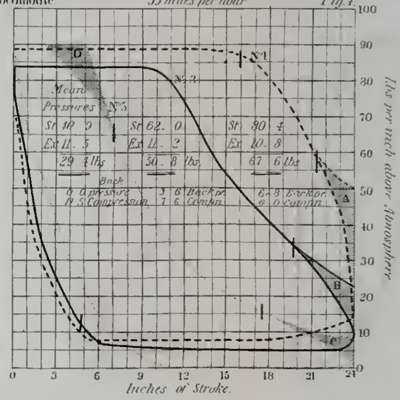
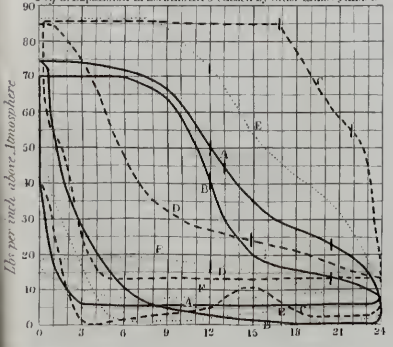


Fig 5. Expansion in Locomotives caused by Water in the Cylinder.

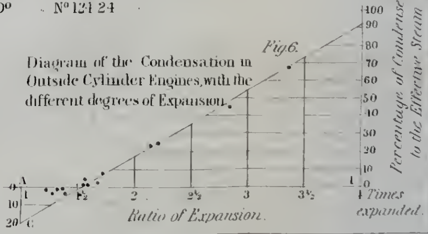


A & B *Orion Passr Engine 39 Miles per hour.*
C & D *No 127 Goods Eng. 18 " "*
E & F *Do Do 15 " "*

Stroke of No 13. 20 Inches
Do " No 42. 20 "
Do " No 124 24 "

Fig.6.

Diagram of the Condensation in Outside Cylinder Engines, with the different degrees of Expansion.



subject. In column 5 are given the relative amounts of work done by steam, under the admissions named in column 1, being directly as the effective mean pressures in the cylinder, which are found by a rule to be afterwards given.

Efficiency of Steam by Expansion in the Cylinder of the Locomotive in Actual Practice.

For Maximum Pressures during admission of 60 lbs. to 120 lbs.

Periods of admission or points at which the steam is cut off in parts of stroke.	Water as steam consumed in pounds per horse power per hour.	Relative efficiency of steam in actual practice.	Possible maximum efficiency.	Relative work done by steam of the same maximum pressure in the cylinder.
per cent.	lb.			
10	16·2	2·22	3·30	15
12·5	16·7	2·15	3·08	20
15	17·3	2·08	2·90	24
17·5	17·8	2·02	2·73	28
20	18·4	1·96	2·60	32
25	19·5	1·85	2·39	40
30	20·6	1·75	2·20	46
35	21·7	1·66	2·05	52
40	22·8	1·58	1·92	57
45	23·9	1·50	1·80	62
50	25·0	1·44	1·69	67
55	26·1	1·38	1·60	72
60	27·2	1·32	1·51	77
65	28·3	1·27	1·43	81
70	29·4	1·23	1·35	85
75	30·5	1·18	1·28	89
100	36·0	1·00	1·00	100

The periods of admission of steam to the cylinder may be varied by link-motion from 75, the greatest useful period, to 10 per cent. of the stroke. By the table, the relative efficiency varies within these limits from 1·18 to 2·22, the variation being as 1 to 2 nearly. It follows, that under the most favorable existing circumstances, *the utmost possible efficiency of steam worked expansively* in the locomotive by the link-motion, is *about twice* that of the steam when worked *under full gear;* that is, the *same quantity of steam does twice the quantity of work.*

By a consideration of the effective mean pressures in the first table, it appears that the average rate at which it increases with the period of admission is expressed by the following rule:

Rule III.—*To find the effective Mean Pressure in the Cylinder, in terms of the Maximum Pressure, for a given per centage of admission.* Multiply the square root of the per centage of admission by 13·5, and subtract 28 from the product. The remainder is the effective mean pressure in per cent. of the maximum pressure of steam admitted. By this rule the following table is composed:

Effective Mean Pressure in the Cylinder for Various Admissions.

For Maximum Pressures of 60 lbs. to 150 lbs.

Periods of admission in parts of the stroke.	Effective mean pressures in parts of maximum pressure.	Periods o admission in common fractions of stroke.	Effective mean pressure in common fractions of the maximum pressure.
per cent.	per cent.		
10	15	1-10th.	1-7th full.
12·5	20	. . . .	. . . .
15	24	1-8th.	1-5th.
17·5	28	. . . .	. . . .
20	32	1-6th.	1-4th.
25	40	1-5th.	1-3d.
30	46	1-4th.	1-25th.
35	52	1-3d.	1-2d.
40	57	. . . .	. . . .
45	62	. . . .	. . . .
50	67	1-2d.	2-3ds.
55	72	. . . .	. . . .
60	77	. . . .	. . . .
65	81	2-3ds.	4-5ths.
70	85	. . . .	. . . .
75	89	3-4ths.	9-10ths.

In all well protected cylinders, with blast orifices not less than $\frac{1}{16}$th of the area of the cylinder, the foregoing rules and tables of data apply to the action of steam at speeds under 30 to 40 miles an hour, as the writer has fully shown in his work on *Railway Machinery.* For speeds amounting to 55 to 60 miles an hour, the loss by imperfect exhaust causes a large increase of consumption per horse power per hour, of from 33 to 12 per cent., according to the amount of admission. With steam ports of about $\frac{1}{14}$th, and blast orifices $\frac{1}{14}$th of the cylinder, the rules likewise apply, at speeds under 30 to 40 miles an hour. At the higher speeds, the useful power is considerably impaired by imperfect exhaust.

The proportions of the *Great Britain*, from the performance of which the foregoing results are deduced, may be repeated here as standard ratios for practice, until superior results are obtained.

Sectional area of cylinder, ...	1
" " steam port, ...	1-10th
" " blast orifice, ...	1-11th

Lap of valve, 1¼ in.; travel, 4¾ in. in full gear: lead, ¼ to ⅜ in.

In a second paper, the writer discusses the *conditions* necessary for the successful expansive working of steam in locomotives. The following is a comparison of the actual results of engines working with ordinary *gab-motions* and with *link-motions.* The engine *Europe*, on the Edinburgh and Glasgow Railway, cylinder 16×18 inches, wheel 6 feet, doing one week's work in 1849, with *gab-motion*, consumed an average of 19 cwt. of coke per day, and 2 cwt. of coal. As, in the locomotive boiler, coal is about two-thirds of the value of coke, 2 cwt. of coal is equivalent to 1·33 cwt. of coke; and the consumption per day may be stated at 20·33 cwt. coke.

The same engine, fitted with *link-motion*, used at the same season in 1851, and doing the same work, 12 cwt. of coke, and 3 cwt. of coal daily, equivalent to 14 cwt. coke. Over a run of 94 miles, the expenditure becomes

24·22 lbs. per mile with gab-motion.
16·70 " " link-motion.
———
7·50 " reduction, or 30 per cent. with link.

The periods of admission in the two cases would be about 70 and 45 per cent., and by the table of efficiency the consumption would be as 1·50 to 1·23, showing an economy of only 18 per cent., or barely two-thirds of what was actually made. The greater actual efficiency must in great part be due to the superior opportunity of working with high pressure, during the admissions offered by the link.

Again, the test may be applied by measuring the water consumed. The following are a selection of cases from the writer's own experience and observation:

Engine with Link-motion; cylinder, 15 × 20 inches; wheel, 6 feet. Edinburgh and Glasgow Railway.

Date.	Engine.	Mean speed. Miles per hour.	Average train of Carriages.	Consumption of water in feet, per mile.	Remarks.
1851 August 26.	"Orion," ordinary train.	19·6	16	2·97	Stiff wind ahead.
" 26.	Do. do.	24·4	7	2·01	Do. favorable.
August 27.	Do. do.	24·4	7	2·22	Do. ahead.
" 27.	Do. Express.	32·0	5	1·65	Do. favorable.
1850. Sept. 7.	Do. do.	32·7	5	1·65	Slight wind ahead.

Engines with fixed Gab-motion, cylinder 16 × 18 inches, wheel 6 feet. Edinburgh and Glasgow Railway.

1850. Sept. 3.	"America," ordinary.	21·5	13	3·01	Wind favorable.
October 10.	"Nile," Expr.	29·0	7½	3·00	Do. ahead
" 21.	"Niger,"	....	7	2·80	Calm.

Express engine, with fixed Gab-motion; cylinder, 16 × 18 inches; wheel, 6 feet. North British Railway.

1851.	Express.	38·5	5	2·70	Calm.
	"	38·5	5	2·70	Do.
	"	38·5	4	2·96	Wind ahead.
	Mail.	35·7	7	3·05	Calm.
	Ordinary.	22·0	12	3·45	Calm.

These results show, as before, that under similar circumstances, what has been deduced from an independent examination of indicator diagrams, taken under the link-motion, as to the *economy* of steam *worked expansively*, is fully borne out by a direct appeal to the relative consumption of coke and water.

(To be continued.)

For the Journal of the Franklin Institute.

Description of Lahaye's Patent Self-Acting Brake.

Explanation of the Figures.

a	Timbers of car body.
b	" of trucks.
c	Bumper of pulling bar.
d	Pulling bar coupled to engine or train.
e	Shaft communicating power of pulling bar, *d*, when train is checked to brake blocks.
f	Fixed pivot of shaft, *e*.
g	Pulling rods, acting upon brake blocks from shaft, *e*.
h	Springs acting upon all brake blocks by *g* and *i*.
i	Tie rods connecting brake blocks.
k	Hangers suspending brake sockets from truck.
l	Brake blocks, movable in their sockets.
m	Sockets, channeled to receive brake blocks.
n	Lifting bars, moving with "
o	Bell crank levers, moving detaching rods *q*.
p	" " " "
q	Detaching rods, acting upon cranks, *r*.
r	Cranks, moving detaching shaft.
s	Tongue, on detaching shaft, moving pulling bar, *d*, out of gear.
t	Rollers, between brake block and sockets.
u	Slots, for motion of rollers.
r	Pulling bar spring.

Operation of Brake, Fig. 1.—The car is supposed to be coupled to an engine, by the pulling bar *d* at *c*. Immediately on the steam being shut off, the momentum of the car and train behind it presses the pulling bar upon the engine at *c*; this pressure is communicated by a shoulder in *d*, through the shaft *e*, pulling rods *g*, springs *h*, and tie rods *i*, to all the brake blocks, causing them to act upon all the wheels with a force proportioned to the resistance at *c*, and ceasing only with the latter resistance.

Operation of Detaching Levers, Fig. 2.—The brake blocks are supposed to be pressed against the wheels, the engine reversed, the train stopped, and required to be backed. The wheel B, fig. 2, turning in the direction of the arrow, moves the brake block, *l*, upwards in the same direction, carrying with it the lifting bars, *n*, acting upon the bell cranks, *o p*, detaching rods, *q*, and crank, *r*, thus moving the tongue, *s*, upwards, and ungearing the pushing bar, *d*, allowing the car to be moved backwards by the bar, *d*, pressing against the ring bolt by a slot in *d*, through which said ring bolt passes.

General Remarks.—The detaching motion is instantaneous in its action. The ordinary hand brake can be applied to every car with the self-acting brake, and acts independently of the latter. When it is not required to back the train, the pressure of the brake blocks is relieved immediately by the forward motion of the pulling bar, *d*.

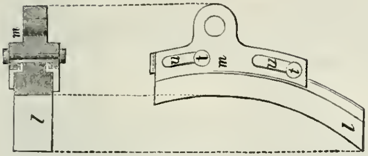
The chief advantages of this brake are as follows:

1st, It is self-acting, operating only when it is desired to stop the train or diminish its speed, and relieving the wheels of its pressure instantly, on the cars feeling the forward or backward motion of the engine.

2d, Its action is instantaneous on every car in the train, commencing the moment the steam is shut off the engine, and ceasing only with the motion of the cars.

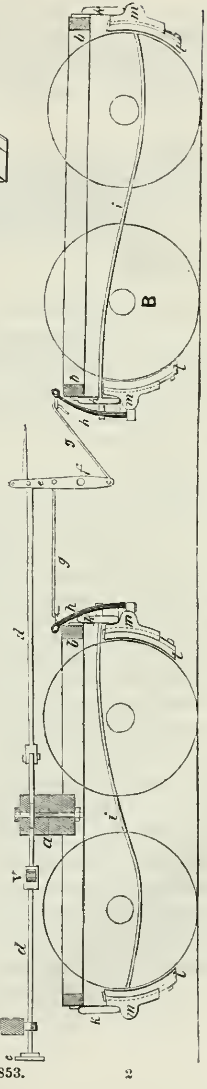
3d, Its power is exactly proportioned to the necessity for the gradual or sudden stoppage of the train, resulting from the judgment of the engineer in the management of his engine; the brakes acting with moderate force when the steam is shut off the engine, with increased intensity if

Fig. 3.



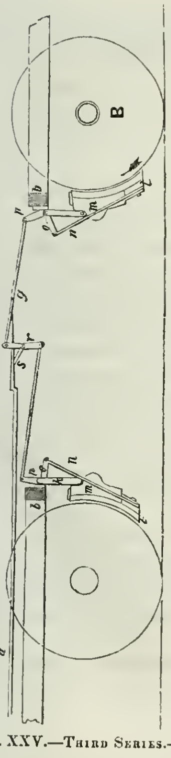
Brake Blocks.

Fig. 1.



Braking Apparatus.

Fig 2.



Detaching Levers.

the tender brake be applied, and with sufficient force to back the wheels (if required) if the engine be reversed.

4th, It is simple in its construction and operation, not liable to derangement, and so constructed as to allow the use of the ordinary hand brake on every car, when the latter is moved separately.

CERTIFICATES.

Lahaye's Patent Brake has been in operation upon the passenger trains of the Philadelphia and Reading Railroad for several months past. It has worked to our satisfaction, has caused no expense for repairs, remaining in the same condition as when first put on, and proving on many occasions eminently useful in arresting the rapid motion of the train, when danger was observed and the engine reversed.

I consider it one of the most valuable inventions ever made to increase the safety of railroad traveling, as by its use a passenger train can be stopped in about half the space usually required.

G. A. NICOLLS,
Eng. & Sup. Philad. & Reading Railroad.

Reading, Pa., March 16th, 1852.

Mr. John Lahaye's Self-Acting Brake has been in operation on the passenger cars of the Philadelphia and Reading Railroad for several months, and its operation has been such as to give entire satisfaction. I think a fair trial of it by any railroad company will convince them that it is the only contrivance of the brake kind that can be relied on when there is a necessity for stopping a train in case of collisions.

I would recommend it particularly to railroads using but a single track; for them I think it indispensable.

JAMES MULHOLLAND,
Master Machinist, Philad. & Reading Railroad.

Reading, Pa., March 16th, 1852.

Description of Pilbrow's Water Waste Preventer.[*]

This article, manufactured by Guest & Chrimes, of Rotherham, is introduced for the purpose of detecting and preventing waste of water supplied to the inhabitants of towns by water works, whether such waste be wilful (as is too often the case amongst the inconsiderate occupiers of cottage property), negligent, or accidental from leakage or bursting of pipes, leaving open taps, &c., and is especially applicable, and may be said to be almost indispensable, where water is supplied on the "high-pressure" and "constant-supply" system. When it is considered that under this system, at a pressure of, say 150 feet, the smallest tap in ordinary use—viz. $\frac{3}{8}$-inch—will, if left open for only one night of ten hours, waste from four to five thousand gallons of water, it will be most manifest that any article which will prevent a waste of such serious magnitude is one that must fairly claim immediate attention, and insure extensive adoption.

The Water Waste Preventer is calculated and guaranteed not only to remove this difficulty, but also to obviate the necessity of stop-cocks, as these will be no longer required for the purpose of shutting off water whilst repairs are being made to taps and pipes in consequence of leakage, the removal, or repairs of broken taps or service pipes, bursting of pipes from frost, or any other ordinary cause.

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[*] From the London Civil Engineer and Architect's Journal, May, 1852.

Fig. 1 shows "the Preventer" in section with the ball in two positions, one as when the supply of water has been drawn, and the ball thereby brought to the top of the tube, closing the service aperture, as at B; the other when all is shut off, as at A. Fig. 2 shows "the Preventer" with ferrule for connecting to the main pipe, as at A, and to the service supply pipe, as at B. It consists of a tube of cast iron, or other material, having flanches at each end, one to attach to the main supply pipe, the other to the service supply pipe; a ball of peculiar material and gravity is inserted in the tube. The tube when attached to the main supply pipe, is laid at an elevation varying according to the pressure at which the water is supplied, the service end being the highest; if there is no leakage or draw upon the pipes, the ball will be, and remain at the bottom of the tube, as shown at A; but when water is required to be drawn, and the tap is opened for that purpose, or should the pipe be burst, or water running to waste from any cause, the ball immediately and gradually ascends until the quantity of water the machine is intended to deliver has taken place, when the ball will have moved to the top of the tube (as at B), and closed the aperture of the service supply pipe, and the delivery will have ceased until the tap be closed, or the defects remedied, when the ball will return again to the bottom of the tube, and further deliveries in succession may be obtained. From this it will be seen that waste of water from the taps being left open for a longer time than while the required and limited delivery is taking place, IS IMPOSSIBLE. After such delivery has taken place, and whilst the tap continues open, the ball will remain at the top of the tube, closing the service pipe aperture, so as that the merest driblet can escape. And this will be the case under all the circumstances from which undue waste of water arises—whether from wanton mischief done to the pipes or taps—from bursting or other leakage of pipes—from taps in houses, yards, or water-closets being left open, or any other cause, wilful or accidental.

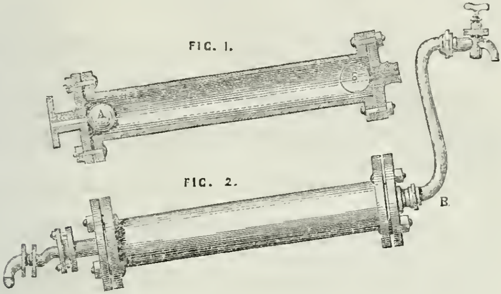


FIG. 1.

FIG. 2.

AMERICAN PATENTS.

List of American Patents which issued from Nov. 9th to Dec. 7th, 1852, *(inclusive,) with Exemplifications by* Charles M. Keller, *late Chief Examiner o Patents in the U. S. Patent Office.*

NOVEMBER 9th.

20. For an *Improvement in Oil Presses;* William P. Chadwick, Edgarton, Massachusetts.

Claim.—"What I claim as my invention is, the arrangement of the screw within th body or interior of the box, in combination with so applying it to one head of the box, an to the platen, that by its revolution in one direction, the platen will be drawn towards th said end of the box, all substantially in manner and for the purpose as above specifie not meaning to claim the combination of a screw, platen, and box, but intending to lim my claim as above described."

21. For an *Improvement in Printing Presses;* Joel Densmore, Blooming Valley, Pennsylvania.

Claim.—"What I claim as my invention is, the combination, substantially as describe of the fingers or grippers, for seizing the sheets and holding them to the cylinder, and th fingers for throwing the sheets off from the cylinder, said fingers or grippers being attached to shafts arranged longitudinally to the cylinder, and attached thereto, and bein turned to give the necessary movements to the fingers by the revolution or vibration c the cylinder through the agency of cranks and rods, or their equivalents."

22. For an *Improvement in Marine Signals;* Thomas H. Dodge, Nashua, New Hampshire.

Claim.—"What I claim is, placing the lamp on a movable pedestal, or its equivalent inside the many-sided signal-box, and raising or lowering the same from one colored glas to another, by means of a cord and pulley, or their equivalents, the whole being constructed, arranged, and operating in connexion with a signal, in the manner and for th purposes substantially as herein described."

23. For an *Improvement in Turning Jaw Vises;* Abijah Halbert, Augusta, Georgia

Claim.—"I am aware that the revolving jaw of a vise has been set, and then secure to any desired angle with the fixed jaw, and I do not claim so doing; but what I do clai as my invention is, constructing the jaw of a revolving vise, with a flanch or projectio provided on the edge thereof with a female screw, in which mesh the screw, or othe equivalent, operating on said jaw, in the manner and for the purposes set forth and shown by which I am enabled to both set and secure the revolving jaw at the same time."

24. For an *Improvement in Saddles;* Thomas Mardock, Cincinnati, Ohio.

Claim.—"What I claim is, the construction of a saddle with seat attached to the pommel and cantle, by lips, as described, or in any equivalent manner, so as to be easily removable for the inspection, and, if need be, alteration of any part of the saddle."

25. For an *Improvement in Mode of Throwing Shuttles in Looms;* Stephen C. Mendenhall, Richmond, Indiana.

"My invention relates to improvements in looms for weaving two cloths united at th selvedges; that is, for weaving a continuous cloth, the weft, instead of being passed bac and forth by the shuttle, passes completely round, or forms a continuous circuit without selvedge."

Claim.—"Having thus fully described the construction and operation of my 'Columbia Bagging Loom,' what I claim is, the combination and arrangement of the sprin triggers, cords, and treadles, so that the depression of any one of these treadles shall release the triggers on the forward movement of the lay, and allow the picker staff to actuate the shuttle, substantially as set forth."

26. For an *Improvement in Hand Looms;* Stephen C. Mendenhall, Richmond, Indiana and Obed King and Ezra King, Salem, Iowa.

"Our invention consists, first, in effecting a movement of any number of heddles, an varying the number of the same by a motion derived from the lay, so as to produce fabric of two or more looms with the same loom, without the use of cams, and without removing any part of the machinery; and, second, in effecting a throwing of the shuttle by an inclined plane action, which operates independently of that for shedding the web."

Claim.—"Having thus fully described our invention, what we do claim is, the combination of the nerve, operated by lay, inclined plane, and its guides, and adjustable pin, or their equivalents, combined and operating as described, so that we can operate and vary the number of heddles, substantially as and for the purpose set forth.

"We are aware that the picker staff has been operated by hooks, alternately raised from the shoulders on the picker staff by pins on a vibrating slide, operated by grooves in the treadle cam; this we do not claim: but we do claim the combination of the inclined plane, on picker staff spring, and hooks, for the purpose of sliding the hooks, in the manner and for the purpose specified."

27. For *Improvements in Steering Sab-Marine Vessels;* L. D. Phillips, Michigan City, Indiana.

Claim.—"What I claim as my invention is, the arrangement of the shaft of the propeller, so as to pass through and be guided by the tiller, or the equivalent thereof, mounted on an universal joint, in order that a propeller may be driven by one hand, while the vessel is steered in any direction by the other, substantially as herein set forth.

"I likewise claim the combination of an universal rudder, with a series of keels arranged on the top, bottom, and sides of the vessel, to aid in steadying her, and to facilitate the steering of her in various directions, by means of an universal rudder, substantially as herein set forth."

28. For an *Improvement in Horse-Shoe Machinery;* Solomon Shetter, Alleghany, Pennsylvania.

"My improvement consists in the arrangement of certain levers, revolving dies, and cams, in the manner hereinafter described, for turning and forming a horse-shoe."

Claim.—"Having thus fully described my improvement, what I claim therein as new is, the arrangement of shifting dies and adjustable levers and cams, substantially in the manner and for the purpose set forth."

29. For an *Improvement in Twisting Tubes in the formation of Roving;* Harvey Silver, Lowell, Massachusetts.

Claim.—"Having fully described my invention and its adaptation, what I claim as new is, 1st, The construction and use of tubes for giving countertwist to roving, by having a slot in the side, in such a manner that the roving can be laid into the tube without the use of a hook, as described.

"2d, The construction, arrangement, and use of tubes, for giving countertwist to roving in such a manner, that without disengaging the driving apparatus, the tube can be so turned on its support, that a hook can be passed between the bosses of the rolls through the revolving tube, to draw the roving into the tube, without stopping the parts, as described.

"3d, The construction and use of tubes for giving countertwist to roving, by making them in two parts, into one of which the roving can be adjusted and then dropped into the other, giving it the necessary rotary motion to form the twist."

30. For *Improvements in Machinery for Crimping Metal Bars;* Giles Slocum and M. T. Sayles, Lansingburgh, New York.

"The invention consists in a peculiar manner of operating a pair of dies, one or both of which may be flexible, said dies passing between pressure rollers, which force the dies together and crimp or bend the iron, as will be fully described hereafter."

Claim.—"We do not claim the flexible die, nor the combination of the permanent die and flexible die, as they have been previously used; but what we do claim as our invention is, the peculiar manner of operating said dies, as herein shown and described, viz:—by means of the pressure rollers and the lower rollers being fixed permanently in the frame, and the upper rollers arranged so as to yield to the die, when necessary; the movable bed being attached by a cord or chain to the roller, by turning which, the bed is drawn between the upper rollers and the lower rollers, the upper rollers forcing or compressing the flexible die upon the permanent die, and bending or crimping the bar, as set forth."

31. For an *Improvement in a Cooking Range;* George S. G. Spence, Boston, Massachusetts.

Claim.—"What I claim as my invention is, my improved combination of a heat radiating chamber applied to the rear end, and two draft flues applied to each of the four faces, at top, bottom, and two sides of an elevated oven of a cooking range; that is to say, I claim the combination of the heat radiating chamber (against the end of the oven), two draft flues (against the bottom of the oven), two flues (against one side of the oven), two draft flues (against the other side of the oven), and two draft flues (against the top of the oven), all connected and made to operate together, substantially as specified; my said combination of flues, as they are above arranged, causing the smoke and other volatile products of combustion, to pass from the back of the flue space under the boiling chamber, into a flue leading under the rear part of the oven, and transversely across, or from side to side of the oven, thence up a flue leading against the side of the oven, thence down a flue leading against such side of the oven, thence into a reservoir flue leading transversely across and under and against the bottom of the oven, thence upwards into and through a flue leading horizontally and along the other side of the oven, and from front to rear of it; thence into and through a flue leading horizontally against such second or other side of the oven, thence into a flue leading across the top of the oven and from side to side of it, thence into and through another flue leading over and against the said top, and in an opposite direction to the last mentioned, and thence into the chimney or discharge flue."

32. For an *Improvement in Brick Machines;* Henry H. Strawbridge, New Orleans, and Daniel Tyson, Covington, Louisiana.

Claim.—"What we claim as our invention is, the roller in combination with a reciprocating series of moulda, for the purpose of gauging the quantity of clay to be compressed into the said moulds, the several parts being arranged and operating as herein described.

"We also claim the method herein described of finishing the surface of dry clay bricks in moulds, by first shaving off the surplus material, and then smoothing the shaved surface by rubbing it under heavy pressure while confined in the mould, to prevent it from breaking under the operation, as it would do if not so confined."

33. For an *Improvement in Automatic Fans;* Seth E. Winslow, Kensington, Pennsylvania.

Claim.—"What I claim is not mounting a fan upon a rocking chair, and operating it from the motion of the chair, as that has been done before; but what I do claim as my invention is, the mode of operating the fan by means of the rod impinging upon the floor, and made to re-act by means of a spring, substantially as herein set forth."

34. For an *Improvement in Gas Burners;* A. H. Wood, Boston, Massachusetts.

Claim.—"Having described my improvement in gas burners, what I claim as my invention is, the use in a gas burner of a distributor, constructed substantially as above described, for the purpose of producing a steady jet or flame, and for preventing the blowing and waste of gas in the burner."

35. For an *Improvement in Reciprocating Die-Spike Machinery;* Moody Belknap, Assignor to Moody Belknap and Lyman Kinsley, Canton, Massachusetts.

Claim.—"I do not claim a series of two or more griping or holding dies made to rotate around one common axis or shaft; nor do I claim reciprocating dies, each provided with its own griping die: but what I do claim as my invention is, the combining the two reciprocating bed dies (affixed to a carriage having a horizontal movement as stated), with the griping lever as the upper die for both, so as to operate therewith, substantially in the manner as above described."

NOVEMBER 16TH.

36. For an *Improvement in Expanding Bits;* Charles L. Barnes, City of New York.

Claim.—"Having fully described my invention, what I claim therein as new is, so forming and combining the movable and stationary parts of an expansion bit for boring different sized holes, as that a cutting edge shall, at all times, be preserved entirely across the bit, and at the same time the cutting point on the movable part thereof shall always be parallel with the shank of the bit or the line of the hole, substantially as herein described.

"I also claim the rising and falling of the movable part of the bit, as it is contracted and expanded, by means of the inclined slots and set screws, or their equivalents, so that the lip on the movable part shall become the cutter when boring the largest sized holes (the other lip being at rest), and the lip on the stationary part shall become the cutter when boring small-sized holes, the other lip being at rest, by which means I am able to form the lips of the proper shape for different sized holes without changing the cutters, substantially as described."

37. For an *Improvement in Seed Planters;* Levis H. Davis, Samuel and Morton Pennock, Kennett Square, Pennsylvania.

Claim.—"Having described our improvements in seeding machines, what we claim as our invention is, 1st, The employment of the sigmoid, or other similarly curved or angular receiving and discharging openings, in combination with the reciprocating slide and feeding stubs, for the purposes specified, the said reciprocating slide having angular points projecting into the aforesaid sigmoid openings, for effecting the discharge of the seed from the outlets from which the stubs are receding, while the latter are feeding the seed towards the opposite extremities or outlets of the openings during each movement of the slide, by means of the inclined sides of said points, and the movement of the slide."

38. For an *Improvement in Flax Pullers;* Lewis S. Chichester, Brooklyn, New York.

Claim.—"I do not wish to limit myself to the mere matters of construction or arrangement of the parts, as these may be greatly varied within the principle of my invention, by the substitution of mere mechanical equivalents. What I claim as my invention, for the purpose of pulling and gathering flax, is the employment of one or more pairs of rollers, substantially as described, in combination with the fingers or separators, or their equivalents, for presenting the stalks to the bite of the rollers, to be drawn in, substantially as described.

"I also claim, in combination with the rollers for drawing in the flax, as specified, the employment of the revolving arm or arms for collecting and drawing the stalks to the bite of the rollers, as described.

"And, finally, I claim, in combination with the rollers for drawing in the stalks, as described, the employment of the fulcrum bar, substantially as described."

39. For an *Improvement in Carpet Looms;* John A. Van Riper, City of New York.

"My invention and improvements consist in the arrangement of mechanism, by means of which a single cam and side bar, with suitable pawls, is made to actuate a positive let-off of yarn, a positive take-up of the woven cloth, and a variable conditional winding up of the woven cloth upon the cloth-beam. My invention further consists in a method of working the trap-boards, which is at once simple and certain, and which is carried into effect by cheap and durable mechanism."

Claim.—"Having thus described my improved loom for weaving carpets and other fabrics, by power, what I claim therein as new is, 1st, Actuating a positive let-off for the delivery of yarn, a positive take-up of the woven cloth, and a variable winding upon a beam of the cloth, delivered from the take-up rollers, by the combination of the crank pin or cam on the disk, or the equivalent thereof, with the alternating bar and its appendages, substantially as herein set forth.

"2d, The method herein described of working the trap-boards, with suitable intervals of rest and motion, by means of the crank cam, the rock-shaft and its arms, the lifting-rods, the cam, and lever, and the other devices acting in connexion with these, for raising, and lowering, and oscillating the lifting-rods, the whole operating substantially as herein described.

"3d, I claim the temples constructed, arranged, and operated, substantially as herein described, so that they will be open during the time the take-up rollers are acting, and closed at the time the lay beats up."

40. For an *Improved Machine for Making Thimbles for Rigging, &c.*, William Field, Providence, Rhode Island.

Claim.—"Having described my improved machine for making thimbles, &c., what I claim therein as new is, arranging the two halves of the forming groove, upon the adjacent ends of two independent revolving mandrels or shafts, which are free to slide towards and from each other, so as to hold the two halves of the groove in contact, while the article is being shaped, and to separate the two halves of the groove, to allow the finished article to drop out.

"I also claim the combination of the divided shaping groove, with a reciprocating former operating in connexion therewith, substantially as herein set forth."

41. For an *Improvement in Cotton Seed Planters;* William A. Gates, Mount Comfort, Tennessee.

Claim.—"Having described my machine for planting cotton seed, what I claim as my invention is, in combination with a rotating cylinder or box, having apertures in its perimeter, the projecting edges or wings, radial ribs or plates, and projecting fingers or prongs arranged around the axle, the whole operating to separate or disentangle the seeds to be sown, immediately previous to the disposition thereof in the furrow, as set forth."

42. For an *Improved Sash Stopper and Fastener;* J. B. S. Hadaway, East Weymouth, Massachusetts.

"The nature of my invention consists in constructing a sash fastener, by the combination of a rocking plate, spiral spring, and levers; the plate and spring being acted upon in such a manner by the levers, that the sash can be securely fastened, or maintained in any position by the fastener."

Claim.—"What I claim as my invention is, 1st, The combination of the rocking plate with the angular lever, the swinging lever, and the spiral spring, constructed and arranged, and operating in the manner and for the purposes herein specified.

"2d, The rocking plate combined with either a simple or compound lever, in the manner and for the purpose herein specified."

43. For an *Improved Blind and Shutter Operator;* Robert V. Jones, Birmingham, Pennsylvania.

Claim.—"What I claim as my invention is, the tubular shanked box hinge, with roller contained therein, as arranged with respect to the roller within the building, when the rollers are connected by a chain, and the whole is constructed as herein described, constituting a convenient blind or shutter operator."

44. For an *Improvement in Tanning;* David Kennedy, Reading, Pennsylvania.

Claim.—"Having described the manner in which my chemical compound for tanning is compounded and used, what I claim as my invention is, the use of borax in combination with nitre, alum, and terra japonica, in solutions of tannin, substantially as and for the purposes herein set forth. The property of the borax I have found of essential use in raising the hides in the tanning process, and preparing it without injury for speedy and safe tanning."

45. For an *Improvement in Bottle Stoppers;* Edward and D. Kinsey, Cincinnati, Ohio.

Claim.—"Having fully described the manner of constructing our self-acting bottle and can stopper, we will proceed to state what we claim as our own improvement. We claim the combination of the ball stopper, together with the rod attached to it, and the guides, in the manner and for the purposes substantially as herein set forth."

46. For an *Improvement in Cylinder Printing Press;* Joel G. Northrup, Syracuse, New York.

Claim.—"Having fully described the construction and operation of my improved press, what I claim as my invention is, 1st, Such a combination and arrangement of a horizontal bed and cylinder of a printing press, as will enable each forward movement of the bed to impart a revolution to the cylinder, for the purpose of taking or giving an impression, and permit it to remain stationary during the reverse movement of the bed, substantially as herein described.

"2d, I claim, in combination with a horizontal cylinder, moving in one direction, with alternate rest and motion, the inking and flying apparatus, substantially as described."

47. For *Improvements in Perspective Drawing Apparatus;* Professor Adolph Richter, City of New York.

"The nature of my invention consists in a new and useful manner or method of delineating upon common unprepared glass, or other transparent medium, with the aid of a simple and cheap instrument, consisting of a compound or composition of ink, a diminishing glass, chalk, &c., artificial and natural objects, and afterwards transferring the same upon paper, canvas, stone, copper, wood, &c."

Claim.—"Having thus fully described my invention, I would state that I am aware that natural and other objects have been traced through and upon the surface of glass or other transparent medium, and I do not claim it; neither do I claim any of the parts of my apparatus when taken separately; but what I do claim is, delineating natural and other objects, in a diminished or increased size, with a lens, when used with the apparatus, and in the manner described."

48. For an *Improvement in Printing Presses;* Stephen P. Ruggles, Boston, Massachusetts.

Claim.—"Having fully described my invention, what I claim therein as new is, so hanging or balancing the bed which holds the form, and move up and down for each impression, upon springs, as that its own weight shall compress the springs to a great extent, and the entire compression of them be completed by drawing the bed farther down whilst in motion, and so that the elasticity ot the springs, when the bed is to rise, will raise it up to the extent of their power, and the upward motion be completed by a separate arrangement, whilst in motion, for the purpose of relieving the machine from overcoming the inertia, in moving the bed from a state of rest, the power to complete its motion being applied near the termination of its movement, substantially as described.

"I also claim the arranging of the frisket and the inking rollers in separate carriages, moving on the same ways with such relative velocities as not to interfere with each other, and so that the frisket may carry off and bring back the sheet quickly, whilst the inking-rollers may travel more slowly and do more perfect work, substantially as described.

"I also claim the pointing of the sheet whilst being prepared for receiving the first impression, by an automatic movement, attached to some moving portion of the press, and so that the operator may use both his hands in guiding and controlling the sheet.

"I also claim the application of a blast of air, or its equivalent, for the purpose of forcing the sheets upon the registering points when the paper is being prepared for the reverse impression, so that the operator may use both his hands in guiding and controlling the sheet.

"I also claim the removing of the sheet from the frisket, or from the press, by means of atmospheric pressure, applied in the manner herein described, or its equivalent, for the purpose of turning over the sheet in its delivery, substantially as described.

"I also claim making the registering points adjustable in the paper table, by passing it through a friction plate, secured between two plates, and so that it may be moved in any direction, by a slight tap, for the purpose of allowing for the unequal shrinking or drying of the paper, or of any movement of the form, after the first impression is taken, substantially as herein described.

"I also claim the combination of the open toggle and adjustable eccentric shaft or pin which operate the bed, for the purpose of regulating the impression, by increasing or diminishing the distance between the bed and platen, substantially as described."

49. For an *Improvement in Bracing and Supporting Card Teeth;* Cornelius Speer, City of New York.

Claim.—"Having described my improvement, what I claim as my invention is, the application of the material herein described, to the front side of the leather fillet holding the card teeth, for the purpose of bracing and supporting said teeth."

50. For *Improvements in Serving Mallets;* Daniel H. Southworth, City of New York.

Claim.—"What I claim as new in my invention or improvement are, 1st, The attachment and use of the clasp or hook to the hollow or concave part of the saddle of a serving mallet, for the uselul purpose of holding it to the rope, while the operator brings the end of the marline from the spool over the pulley in the handle and upper edge of the saddle to the rope, where it is made fast, without being wound round both saddle and rope, as is done in using other mallets, the whole being constructed and arranged substantially in the manner and for the purposes described.

"2d, I claim the attaching to a serving mallet one or more set of thumb-screws, or any analogous device, for the purpose of pressing upon the spool, for the useful purpose of enabling the operator to serve the rope with any degree of tightness the yarn will bear, without winding it round both saddle rope and handle, as is done in using other mallets, the said screws being attached and operating substantially in the manner and for the purposes described."

51. For an *Improvement in Railroad Car Seats;* Daniel H. Wiswell, Buffalo, New York.

Claim.—"Having described my invention and improvement in day and night change-able seats for railroad cars and other purposes, by which, in a moment, the occupant can convert it into a sitting or reclining chair, whether the cars be going or returning, so that the traveler may repose as comfortably as in a bed, or sit as easy as in a parlor chair, what I claim as my invention is, the employment of double jointed slides and jointed rods, with the jointed arms, jointed seat and back, pillars and supports, arranged and operating substantially in the manner and for the purposes herein fully set forth."

52. For an *Improvement in Cordage Machinery;* Hezekiah T. Jennings and Charles S. Collier, Bethany, and Thomas P. How, Buffalo, Assignors to H. T. Jennings and Charles S. Collier, Bethany, and Dorus Perry and Amenzo Beardsley, Middlebury, and Allen Hemmingway, Perry, New York.

Claim.—"What we claim as our invention is, regulating the speed of the receiving reel by the tension of the rope, substantially as herein described."

NOVEMBER 23D.

53. For an *Improvement in Machines for Drilling Stone;* Jos. J. Couch, Philadelphia, Pennsylvania.

Claim.—"What I claim as my invention is. the improvement of making the drill rod to slide through the piston rod, substantially in manner as above set forth.

"And I also claim the combination of the rocker lever, the wedge, the bolt within the lever, the two cam plates, the spring catch, the spring and the projection as applied to the drill shaft, the carriage or block and the slide-ways thereof, and made to operate together, and to actuate the drill substantially in manner as herein before set forth."

54. For an *Improvement in Swinging Churns;* William F. and Nathan Davis, Castleton, Vermont.

Claim.—"What we claim as our invention is, the combination of the swing slotted board, wheel, rock shaft, and lever, for the purpose of producing two complete motions of the dash from one full oscillation of the pendulum bars, substantially as herein described, to be denominated, 'The Oscillating Double Acting Dash Churn.'"

55. For an *Improvement in Pincers for Operating Pile Wires;* Augustus Faulkner, Walpole, New Hampshire.

"The nature of my invention consists in withdrawing, supporting, carrying, replacing, and releasing the figuring wires, by means of a claw, operated automatically by the moving parts of the loom."

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the manner herein described, of constructing and operating the claw for withdrawing, carrying, replacing, and releasing the figuring wires, viz:—by making one of the jaws fixed, and providing it with a pin or projection, extending into a suitable slot in the sliding part of the claw, so that as said part moves back and forth, in contact with the fixed part of the jaw, the pin or projections therein will, when the figuring wire is to be seized, keep it in position for being properly caught in the claw, and when it is to be released, will prevent it from moving with the sliding jaw, as set forth."

56. For an *Improvement in Spaces for Setting Type;* E. C. Harmon, Troy, New York.

"The nature of my invention consists in the employment of an elastic spring 'space,' of cimi recta, or other suitable shape, the object of said spring space being to facilitate the art of setting type."

Claim.—"What I claim as my invention is, the cimi recta, or other more suitable shaped elastic space for facilitating the art of setting type, or for saving the time and labor usually expended in 'spacing out,' 'thin spacing,' regulating the distance of words in the same line from one another, and 'correcting proof,' in the manner herein set forth."

57. For an *Improvement in the Mode of Generating Heat;* William H [illegible]tell, Kensington, and Jos. Lancaster, Spring Garden, Pennsylvania.

"The nature of our invention consists in the adaptation of, or the rendering available, tar, as a fuel for the production of the intense and steady heat required for the melting or manufacture of glass, by introducing it into the furnace, in combination with water, or the vapor of water."

Claim.—"We do not claim the use of tar as a fuel, as that is well known and practised in the manufacture of gas; but, what we do claim as our invention is, the adaptation of, or rendering available, tar as a fuel, for the production of the intense and steady heat required for the melting and manufacturing of glass, by introducing water, or the vapor of water, into the furnace, in contact, or in close proximity, or in combination or mixture with the tar, substantially in the manner set forth above."

58. For an *Improvement in Mode of Fastening the Palings to the Rails in Iron Fences;* George Hess, Easton, Pennsylvania.

"The nature of my invention consists in providing the horizontal bars and the palings with quadrants, segments, circles, cylinders, triangles, and other devices cast to them, for the purposes herein described and set forth, making it a fence or railing, for level, rising, or descending ground."

Claim.—"What I claim is, the circular projection, or its equivalent, on the rail and lower part of the paling, in combination with a corresponding cavity on the lower rail, so arranged, that by giving a partial rotation to said rail, the palings will be clamped to the rails, in the manner and for the purpose herein described."

59. For *Improvements in Machinery for Making Wadding;* Hiram T. Lawton, Troy, New York.

Claim.—"Having fully described my improvement in the foregoing drawings and specification, what I claim is, 1st, Ironing the two surfaces of the combined material, after it has been sized and doubled, by giving the iron rollers a reverse motion to that of the bat, for the purpose and in the manner set forth.

"2d, I also claim the arrangement of the frames supporting the sizing and drying apparatus, one above the other, so that the sheets of fibrous material forming the outsides of the wadding, may be more readily sized and dried, independently of each other, and also for the purpose of facilitating the introduction of any number of bats of fibrilous material between the sizing sheets, in order to increase the thickness of the wadding, or batting, substantially in the manner herein described."

60. For an *Improvement in Processes for Preparing Paints;* Heman S. Lucas, Chester, Massachusetts.

Claim.—"What I claim as my invention is, the process of treating magnesian minerals, such as serpentine silicates of magnesia and iron, and similar rocks, by mineral acids, to prepare from the sedimentary or insoluble, or undecomposed portions of such rocks, a mineral product which I call a basis, to be used in the preparation of pigments, substantially as set forth in the specification."

61. For an *Improvement in Harvesters;* John H. Manny, Waddam's Grove, Illinois.

"My invention and improvements relate to the frame of the machine, to the truck by which it is drawn, to the mode regulating the height of the cut from the ground, to the construction of the cutting apparatus, and to the arrangement of the wheel which carries the outer end of the platform, and drives the cutter, with respect to a scraper for clearing the cut grass of the track next the standing grass, in such manner that the track cleared by the scraper, during the cutting of one swarth, shall be run upon by the driving wheel while the next swarth is being cut."

Claim.—"Having thus described my improvements, and indicated some of the modifications of which they are susceptible, what I claim as my invention is, 1st, The arrangement of the track scraper and driving wheel, in such a manner that the latter, while the machine is cutting one swarth, will run in the track cleared by the former, when the machine was cutting the previous swarth, as herein set forth. But in this patent I make no claim whatever to the track scraper itself.

"2d, The projections on the underside of the upper bars of the finger, in combination with the chamber or recess, on the lower inside corners of said bars, to counteract the tendency of wire grass and other fibrous obstructions, to pass in between the cutter bar and the sides of the recess in the upper part of the finger in which it is guided.

"3d, Forming the guard fingers of two parts interlocked at the point, substantially as herein set forth, so that the grass cannot lodge in the joint, and form an impediment to their entering between the stalks of the standing grain.

"4th, In combination with a raker stand or seat, I claim a removable platform, or raking bottom, constructed with a wing that extends from the outer end of the cutter, over the frame, and holds up the butts of the straws above the stubble, which otherwise would obstruct the discharge of the grain from the platform, substantially as herein set forth."

62. For an *Improvement in Printing Presses;* Charles Montague, Pittsfield, Massachusetts.

Claim.—"I do not claim placing the bed plate in a vertical position, as I am aware this has been done before; but what I do claim as my invention is, placing the bed plate in a vertical position, when a reciprocating motion is imparted to it, by which the impressions can be made at each forward movement of the said bed plate, substantially as herein set forth.

"I also claim the combination of the vertically acting bed, with a cylinder or cylinders, arranged in such a manner, that the forward movement of the bed will impart motion to the cylinder or cylinders, to give or take an impression, and allow said cylinder or cylinders to remain stationary, during the return movement of the bed, substantially as herein set forth."

63. For an *Improvement in Boot Trees;* David Sadleir, McWilliamstown, Pennsylvania.

"The nature of my invention consists in forming cavities in the hinder part of a boot tree, and inserting therein a series of levers and friction rollers, which being operated by a screw, and made to expand the tree whilst in the boot, by bearing against the shin piece."

Claim.—"Having thus described my invention, what I claim therein as new is, 1st, The arrangement and combination of the levers, friction rollers, screw, and slide, or their equivalents, with the back part of the tree, which, when contracted, all bed closely therein, as and for the purpose herein described."

64. For an *Improvement in Printing Presses;* Aaron H. Cragin, Martin Buck, James H. Buck, and Franklin A. Tenney, Assignors to Aaron H. Cragin, Lebanon, New Hampshire.

Claim.—"Having described our improved printing press, what we claim therein as new is, 1st, The arrangement and combination of the movements, in connexion with the bed, by which an extent of motion is imparted to the said bed, much larger than that of the sweep of the operating crank, whilst the whole of the said movements only occupy the space within the frame work of the press below the bed, viz:—the pinion shaft, having pinions upon it, which gear into stationary racks made fast to the sides of the frame, and into racks secured to the underside of the bed; the forked lever (or its equivalent) having its forked extremities connected to the said pinion shaft, and its opposite end jointed to the lever that rises from the oscillating shaft, and the pitman connecting the said lever with the crank on the driving shaft, or the equivalents of said movements, when combined and operating, substantially as herein set forth—disclaiming, however, the principle of imparting motion to a printing press, by direct application of power to the bed.

"2d, We claim the combination and arrangement of the pressure cylinder, and the bed, with the conveying bands, the nippers secured to the said bands, and the cams, for operating the said nippers, substantially as herein set forth.

"3d, We also claim the arrangement of the upper and lower tables, with the pressure cylinder, the bed, the conveying bands, the nippers attached to the said bands, and the cams for operating the nippers, in such a manner that an impression can be made at each right and each left movement of the form under the cylinder, and the sheets be deposited, after receiving their impressions, upon the said lower tables, substantially as herein set forth."

65. For *Improvements in Whiffle Tree;* Dewitt C. Williams, Madison, Ohio.

Claim.—"Having described the construction, and also the operation of my improved safety whiffle tree, what I claim as new is, a shaft, with the ends bent at right angles, and the lever, making part of the same, arranged and operating substantially as herein set forth."

NOVEMBER 30TH.

66. For *Improvements in Machinery for Screwing Bolts, &c.;* John Caswell, Assignor to Archibald C. Powell, Syracuse, New York.

Claim.—"What I claim as my invention is, 1st, The movable ways running in yielding bearings back and forth under the machine, and supporting the vise, substantially as set forth.

"2d, The adjustable stop or gauge on the side of the friction nut working in contact with the movable finger, or any similar projection in the die chuck."

67. For an *Attachment for Converting the Ordinary into a Taper Vise;* Jeremy W. Bliss, Hartford, Connecticut.

Claim.—"What I claim as my invention is, an attachment to the vise, substantially as herein described, and for the purposes set forth, which attachment is removable at pleasure, and requires no change in the construction of the vise to which it is applied."

68. For an *Improvement in Hoes;* William C. Finney, Fayette County, Tennessee.

Claim.—"The improvement that I claim as my invention is, the extension of the blade of the common cotton hoe upward and backward, in a curve form, in such form and manner to enable the laborer, by inserting his instrument and pushing it from him, to remove by the cutting edge any grass, weeds, superfluous plants, &c., as described."

69. For an *Improvement in Mortising Machines;* Jos. Guild, Cincinnati, Ohio.

"My improvements consist in an arrangement of mechanism in a mortising machine, whereby the chisel may be brought into instant action, its depth of cut be exactly and constantly controlled by the operator, or suspended, without interfering with the driving power."

Claim.—"What I claim as new is, the sliding wrist connected with the chisel and also with the driving power, in the manner described, in combination with the mechanism described, or its equivalent, for sliding said wrist, so that the operator can, during the motion of the machine, vary the depth of cut of the chisel, or cause it to be suspended, without disconnecting the driving power."

70. For an *Improvement in Endless Belts to Threshing Machines;* John R. Moffitt, Piqua, Ohio.

"The prominent points of improvement in this invention consist in devices for the prompt and thorough separation of the grain from the straw, which, in the usual machinery for this purpose, is liable to carry off and waste a portion of the grain."

Claim.—"Having thus described the nature of my improvements in machinery for threshing and separating grain, I wish it to be understood, that I lay no claim to originality in passing the screening a second time through the threshing apparatus, as that has already been done; neither do I claim the use of a continuous apron with open slats or interstices, for carrying off the straw; but what I claim herein as new is, the continuous open apron, having its belt formed of links, whose cogs are at one part of their rotation (in connexion with the pinions) or means of propulsion, and are, at another part of their rotation (in connexion with the rollers or other stationary objects), a means of agitation of the said apron."

71. For an *Improvement in the Construction of Ploughs;* Fortunatus E. Richardson, Hicksford, Virginia.

Claim.—"In my cultivator plough there are several parts which are common to ploughs, or such as have been more or less separately or in connexion used by others, the central bar or body of the plough, from which is reared the standard or sheath, the angular wings or stirrers confined to the central bar, the double share or mould board: therefore, to these parts no special claim is made, either separately considered, or in combination; but I claim as my improvement, mounting the double pointed share upon the central shoulder piece, and fastening the same by a link piece, as described."

72. For an *Improvement in Rotary Knitting Machines;* Horatio G. Sanford, Worcester, Massachusetts.

Claim.—"What I claim as my invention is, the combination of the mechanism termed the stop motion, with the rotary knitting machinery of the kind as above specified, the object of the stop motion being to arrest the operations of the machine on breakage of the yarn."

73. For an *Improvement in Rotary Knitting Machines;* David Tainter, Worcester, Massachusetts.

Claim.—"I do not claim the combining one or more draft rollers and a take-up roller, or drum, in one frame, which, when put in rotation, shall carry them simultaneously around with it, so as to draw forwards and wind up a rope or cord, or like manufacture, formed of strands twisted together; nor do I claim the application of a take-up roller or mechanism, as used on either a common warp or flat braid knitting machine; but what I do claim as my invention is, to so combine a draft and take-up roller, and mechanism for revolving it with a rotary series or set of needles, and other mechanism of the above-mentioned peculiar kind for knitting, that such draft roller shall rotate simultaneously, or with the same velocity, with such series of needles, so as to prevent the longitudinal rows of stitches from being produced in helical lines, and the evil consequences resulting to tho fabric therefrom.

"I also claim the arrangement of the draft and take-up mechanism, in connexion with the knitting mechanism, supported by two separate frames, and also their connexion with the mechanism for producing an equal and simultaneous rotation of these frames, all substantially as described, whereby there shall not only be no connexion between the frames to extend through the fabric, but no projection from the frame to come in contact with the presser, stitch wheels, and cam bar, or their respective supports, during the simultaneous and equal rotations of both or either of the said frames."

74. For an *Improvement in Cooking Stoves;* Henry J. Ruggles, West Poultney, Vermont.

Claim.—"Having fully described my improvod cooking stove, what I claim therein as new is, the combination and arrangement of the front and rear flues, and air chamber, substantially as herein set forth."

75. For an *Improvement in the Manufacture of Stone and Earthenware;* Jacob and Freeman Wise, Fredrickstown, Pennsylvania.

Claim.—"What we claim as our invention is, 1st, The mode of attaching the mandrel so that it may revolve on its axis, by means of friction with the clay, and at the same timo be moved from side to side within the mould.

"2d, The model adopted for varying the relative thickness of the different parts of tho manufactured article."

RE-ISSUES FOR NOVEMBER, 1852.

1. For an *Improvement in Steam Boilers and Apparatus to be used on board of Steam Boats to prevent the Explosion of Boilers;* Cadwallader Evans, Pittsburgh, Pennsylvania; dated April 15, 1839; re-issued November 23, 1852.

Claim.—"Having described my invention and some of its advantages, I would say that I do not claim the use of an alloy to allow steam to escape through the opening in tho boiler, caused by its fusion; but I do claim as my invention, the combination of a fusible alloy, confined in a cup, tube, or case, with metallic stem, rod, or other fixture not fusible at the melting temperature of the alloy, which stem, rod, or other fixture is held or kept in position whilst the alloy remains hard, but when said alloy is fused, said stem or its equivalent can move or have motion, by which liberty to move, any valve may be liberated or caused to open and let steam escape, or any alarm may be let off, or any index moved, so that this combination may act as an alarm indicator or safety apparatus.

"I also claim, in combination with said alloy and plug, the heavy slotted weight, the lever, or its equivalent, and the safety or escape valve, and its ordinary weight, acting in the manner and for the purposes herein described."

2. For an *Improvement in Cream Freezers;* Eber C. Seaman, Philadelphia, Pennsylvania; dated October 3d, 1848; ante-dated April 3d, 1848; re-issued November 30th, 1852.

Claim.—"What I claim as my invention is, the arrangement of scrapers at an angle with the bottom and sides of the vessel, as described, so that the action of the rotation shall throw the scrapers against the sides and bottom of the vessel."

3. For an *Improvement in Welding Cast Iron to Malleable Iron or Steel;* Mark Fisher and William Martin, Jr., Newport, Maine; dated October 16th, 1847; re-issued November 30th, 1852.

Claim.—"Having fully described the nature of our improvement, what we claim therein as new is, uniting the steel and cast iron as described, by first preparing the steel in the manner set forth, and then causing the cast iron to flow over and upon the surface of the steel thus prepared, substantially in the manner and for the purpose above set forth."

DESIGNS FOR NOVEMBER, 1852.

1. For a *Design for a Cooking Stove;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, November 2.

Claim.—"I claim as new the general ornamental design and configuration, as exhibited in the drawings, and especially claim the design of each of the fire place doors, and that of the oven doors."

2. For a *Design for a Pump Curb;* John W. Wheeler and Obadiah B. Latham, Seneca Falls, New York, November 2.

Claim.—"What we claim as our invention is, the combination and arrangement of ornamental forms, carvings, and configurations, as represented in the annexed drawing, making an ornamental design for the curb of a chain pump."

3. For a *Design for Stove Plates;* William M. Snow, Providence, Rhode Island, November 2.

Claim.—"What I claim as my production is, the new design consisting of the bead work, mouldings and ornamental configurations herein above described and represented in the drawings, for the side plate of a cooking stove."

4. For a *Design for a Cook Stove;* N. S. Vedder, Troy, New York, November 2.

Claim.—"What I claim as new is, the ornamental design and configuration of cook stove plates, such as herein described, and represented in the annexed drawing."

5. For a *Design for a Parlor Stove;* Washburn Race, Assignor to H. C. Silsby, W. Race, and Birdsill Holly, Seneca Falls, New York, November 9.

Claim.—"What I claim as my invention is, the design and configuration of the several plates, and of the feet, and also of the ornaments separately, as herein shown and described."

6. For a *Design for a Pedestal and Column;* Thomas Law, Assignor to Levi Chapman, City of New York, November 9.

Claim.—"What I claim is, the ornamental design on the pedestal, consisting of the combination of the grapes, leaves, scrolls, and face, in alto or bass relievo, as shown; and also the ornaments for the base, shaft, and capitol of the column, herein described and shown in the accompanying drawing."

7. For a *Design for a Parlor Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the ornamental design of the top plate, the bed plate, the grate plate, the door frame, the foot, and the column base of the stove called 'the Radiator,' as fully set forth and described."

8. For a *Design for a Cannon Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the new and ornamental design upon the bed plate, the lower part of the body of the stove, the grate plate, the octagon frame, the top plate, and the leg, of the stove called 'the Octagon Cannon,' combined, arranged, and having the configuration, as set forth and fully described."

9. For a *Design for a Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the ornamental design upon the front, ends, and feet of the stove, as fully described."

10. For a *Design for Stove Plates;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the ornamental design of the oven doors, the clearing door, the feeding door, the ash hole door, and the configuration and arrangement of the mouldings and ornaments of the frames, as set forth and described."

11. For a *Design for a Franklin Stove;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, November 16.

Claim.—"Having described the parts of the said fire place, and represented the ornamental design of the whole, I claim as new, and of my production, the said ornamental design, substantially as exhibited."

12. For a *Design for a Parlor Grate;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, November 16.

Claim.—"I claim as new, and of my production, the design and configuration of the ornaments of the front plate and mantel or top plate of the fire place, the hearth, the fender plate, and the blower, as represented in the drawings, and as above described, the whole forming an ornamental design for a parlor grate."

13. For a *Design for a Parlor Stove;* Dutee Arnold, Providence, Rhode Island, November 30.

Claim.—"What I claim as my production is, the new design, consisting of the ornamental configurations and raised figures herein above described and represented in the drawings for a parlor stove."

14. For a *Design for a Franklin Stove;* Samuel F. Pratt, Boston, Massachusetts, Assignor to Jagger, Treadwell & Perry, Albany, New York, November 30.

Claim.—"What I claim as my production is, the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for a Franklin Stove."

15. For a *Design for Window Blinds;* Nathan Chapin, Assignor to Nathan Chapin and John F. Briggs, City of New York, November 30.

Claim.—"What I claim is, the design and configuration given the slats of window blinds, as above described, and set forth in the annexed drawing."

DECEMBER 7TH.

1. For *Improved Machinery for Bending Pail Bales, &c.;* Robert Bunker, Rochester, New York.

"The nature of my invention consists in constructing a machine for bending pail bales, by which I can bend from one to twenty, or more, according to the length of the machine, and bend them more perfect and with greater facility than in the ordinary way."

Claim.—"What I claim as my invention is, the combination of the saddle, the brake, the bar, and the movable block, all operating in the manner and for the purpose substantially as herein described and set forth."

2. For an *Improvement in Seed Planters;* Lewis W. Colver, Louisville, Kentucky.

Claim.—"Having fully described my invention, what I claim therein as new is, making the cells in the tops of the grooves made as described, so that they shall carry single grains, and combining therewith a cleaner, which extends into the groove behind the seed, as each cell in turn arrives at or over the seeding tube, for the purpose of carrying around and depositing with a certainty, the seeds of grains, singly, substantially as described."

3. For *Improvements in Saw Gummers;* Richard S. Cramer and Cyrus C. Blossom, Sommerville, Ohio.

Claim.—"What we claim therein as new is, the nut having gudgeons occupying notches in one of the jaws of a saw gumming apparatus, in which the cutting portion is situated between the power and the fulcrum, for the objects explained."

4. For *Improvements in Drilling Machines;* Charles W. Coe, Ashtabula, Ohio.

Claim.—"What I claim as new is, 1st, The peculiar manner of giving the slow automatic feed motion to the spindle, and the fast receding motion, by means of the sliding pinion, collar, and screw which is attached to the spindle, combined with the two sets of cogs, or their equivalents, upon the face of the same disk, the several parts above named being constructed, arranged, and operating in the manner and for the purpose herein shown and described.

"2d, I claim the peculiar method of constructing and arranging the clutch, as herein shown and described, by which the inclination of the clutch may be changed, as described, and the position of the clutch also moved or changed bodily, in a horizontal direction."

5. For an *Improvement in Hats;* Francis Degen, City of New York.

Claim.—"I am aware that metallic rings or bands have been used in helmets and similar articles, for the purpose of a support, but I do not know of any hat in which a strip of foil has been inserted between the leather, or sweat, and the hat; therefore what I claim is, the metallic strip, or strips, inserted between the leather, or sweat, and the hat, and attached to either or both, the hat or sweat, as described and shown."

6. For an *Improvement in Tonguing and Grooving Apparatus;* Phineas Emmons, City of New York.

Claim.—"Having now described my invention and its operation, what I claim, therefore, is, the shaft, connecting rods, cutter stocks and cutters, and slides, in combination with the stationary tongues and grooves, for the purpose of tonguing and grooving boards, &c., as set forth."

7. For an *Improvement in Hot Air Furnaces;* Stephen Gates, Albion, New York.

Claim.—"Having described my invention, I do not claim the employment of a series of upright tubes or flues over a fire chamber, for the purpose of heating air; nor do I claim the use of deflecting plates, simply as such; but I do claim the combination of the deflecting plates with the system of upright flues directly over the fire chamber, when such flues are arranged in the manner set forth, so that each flue of itself shall act as a deflector, and insure a complete circulation through the whole system, substantially in the manner described."

8. For *Improved Machinery for Bending Carpet-Bag Frames, &c.;* Edward L. Gaylord, Newark, New Jersey.

Claim.—"I do not confine myself to the use of any particular mechanism for closing the clamps and griping the bars, nor for drawing them down upon the edge of the bars; but what I claim as my invention is, the employment, for the purpose of bending and forming carpet bag frames, or for bending two or more flat metal bars, edgewise, for any purpose, of a pair of clamps, each moving independently of the other, in the direction of the width of the bars, and having recesses, and self-adjusting movable pieces, as described, combined in any way, substantially as set forth, with a table and bending plate."

9. For an *Improvement in Grain and Grass Harvesters;* C. B. Brown, Griggsville, Illinois.

Claim.—"What I claim as new is, the combination of the crown wheel with the shafts, with their respective pallets, acted upon alternately by the cogs of the wheel, the shafts being connected so as to turn in opposite directions, whereby a vibratory motion is given to the blade.

"I do not claim either of these singly, but when combined for the purposes and in the manner substantially as above described."

10. For an *Improved Galvanic Battery;* Louis Drescher, City of New York.

Claim.—"What I claim as my invention is, the within described improved arrangement of the old voltaic pile, the same consisting in so separating each galvanic pair from that next it, in the series, and connecting them with short wires, and forming the plates with suitable perforations, as that the strips of leather or flannel, or their equivalent, may be at once saturated with the exciting liquid, by immersing the battery therein."

11. For an *Improved Hinge for Moulders' Flasks;* George Grant, Troy, New York.

Claim.—"Having described the construction and operation of my hinge, what I claim as new is, a hinge for moulders' flasks, constructed substantially in the manner as described and represented, by means of which the cope is raised in the jaws of the hinge, as set forth."

12. For an *Improvement in Chairs;* John T. Hammitt, Philadelphia, Pennsylvania.

Claim.—"What I claim as my invention in the above described chair is, operating the leg rest from the motion of the seat and back of the lever and rod, or their equivalent."

13. For an *Improvement in Machines for Manufacturing Hat Bodies;* Lansing E. Hopkins, City of New York.

Claim.—"Having fully described my improved method of planking hat bodies, what I claim therein as new is, 1st, The feeding belts constructed substantially as described, with jointed chains, having cloth stretched between them, as set forth, by which their motion is exactly determined and equal.

"I also claim the combination of the revolving endless planking board or table, with the feeding belts, both moving with the same velocity for the purpose as described."

14. For an *Improved Lock;* Richard Ketcham, Seneca Castle, New York.

Claim.—"What I claim as new is, the circular tumbler, or its equivalent, in combination with the slotted collar, which encompasses the spindle of the knob, said collar and tumbler, or its equivalent, being constructed and operating in the manner substantially as herein described."

15. For an *Improved Padlock;* Rhodolphus Kinsley, Springfield, Massachusetts.

"My improvement consists in the cheapness, convenience, and simplicity of its construction and operation, together with its security against being picked, rendering it valuable for the purposes of railroad cars."

Claim.—"What I claim as my invention is, giving a forward motion to the hasp, and acting upon the tumblers by means of the same key, when the parts are arranged, so that the key acts directly upon a portion of the hasp, substantially in the manner described.

"2d, I claim the double acting spring herein described, only when used in connexion with such a form and arrangement of hasp as will cause it to actuate the tumblers, and not only to throw the hasp out, but hold it thrown out and fully open, in the manner described, confining my claim to this device."

16. For an *Improvement in the Mode of Frosting Glass;* John Levy and Charles Jones, City of New York.

Claim.—"What we claim as our invention is, 1st, Frosting and figuring glass, by fixing the plates to be treated in a trough or vessel containing sand, pebbles, and water, and subjected to a short, quick, vibrating motion, in a longitudinal direction, by any suitable mechanical movement, thus causing the glass to pass through the mass of gritty material before any considerable momentum is imparted to that mass, as more fully set forth herein.

"2d, We claim forming ornaments upon the glass, by the application of patterns, or designs, in connexion with the process of frosting by the action of the sand and pebbles, substantially as set forth herein."

17. For an *Improvement in Manufacturing Wooden Type;* John McCreary, Chesterville, Ohio.

Claim.—"I do not claim the use of a press and dies for the purpose of making wooden type; but what I do claim as new is, the arrangement of the propelling lever, as that by its return movement, in combination with the feeding lever spring, dog and feeding tube, it will move forward as required the blank wood to receive the impression, as above described and set forth."

18. For an *Improvement in Pill Making Machines;* Erasmus A. Pond, Rutland, Ver.

Claim.—"What I claim as my invention is, 1st, Moulding or forming pills by means of two cylinders, having each a number of recesses in its periphery; the recesses in one cylinder matching with those in the other, and each matching pair forming a mould of the required form of the pill, the said cylinders revolving in opposite directions, and the pill mass being conducted between them, substantially as herein described.

"2d, The bands of india rubber, or any sufficiently elastic material, passing round, or partly round, the mould cylinders, for the purpose of expelling the pills from the recesses after the moulds are open, substantially as herein set forth."

19. For an *Improvement in Shingle Machines;* William Stoddard, Lowell, Mass.

Claim.—"Having fully described my improved shingle machine, what I claim therein as new is, 1st, The combination of the rifting knife (connected with the main driver by means of the elastic arms) with the inclined planes, placed upon the rails, as described, for the purpose of enabling the knife to be carried forwards under the block during the forward movement of the said driver, and then be elevated to the proper height to split off a shingle during its return movement, substantially as herein set forth.

"I also claim the arrangement of a secondary driver, placed above and acting independently of the main driver, in such a manner that it will drive the rived shingle from under the block, and deposit it upon the bed forward of the main driver, in such a position that it will be carried forwards to be dressed during the forward movement of the said driver, substantially as set forth."

20. For an *Improved Screw Driver;* Jacob W. Switzer, Basil, Ohio.

"The nature of my invention consists in combining with the ordinary brace and bit stock a self holding screw driver, constructed substantially in the manner as hereinafter described, for holding the screw firmly, while the operation of driving or withdrawing it is carried on."

Claim.—"What I claim as my invention is, the screw driver spring catches, attached to the flat portions of the screw driver, and permitting longitudinal as well as lateral adjustment, and the barrel in which the whole is placed, in combination with the brace and stock, or their equivalents, the whole being constructed and arranged, and operating in the manner and for the purpose substantially as herein set forth."

21. For an *Improvement in Reels for Harvesters;* Warren W. and Clark C. Wright, Canton, Pennsylvania.

Claim.—"What we claim as our invention is, 1st, Extending the axle of the driving wheels so far beyond the carriage as may be necessary to form a pivot for the reels to turn upon and allow of its rotation, by a band, as described, independent of the rotation of the axle, substantially as set forth."

22. For an *Improvement in Utilizing Slags of Furnaces;* William H. Smith, Philadelphia, Pennsylvania.

Claim.—"What I claim as my invention, so as to have the exclusive right therein, is, the process of utilizing the slags of iron and other like furnaces, refining and working the same, substantially in the manner and for the purposes set forth in the specification, whereby I bring into successful operation, for useful purposes, a class of hitherto useless products."

23. For *Improvements in Machinery for Making Wood Screws, &c.;* Cullen Whipple, Assignor to the New England Screw Company, Providence, Rhode Island.

Claim.—"Having described my improved machinery for the manufacture of screws, what I claim therein as new is, 1st, The feeder, composed of a sectional trough, with a close bottom and open top, into which the blank drops and arranges itself before a traversing rod, which pushes it into the griping jaws, substantially as described.

"2d, The combination of the traversing rod, actuated substantially as described, with an adjustable stop for the purpose of setting the blank between the jaws, in the exact position required, as herein set forth.

"3d, The method of operating the jaws and holding them closed with the requisite force to hold the blank firmly between them, without end strain upon the mandrel. by means of toggle or knuckle end joint levers, which are thrown slightly past centres, when the jaws are closed to hold them closed, when they are used in connexion with elastic and long shanked nippers, substantially as herein described, whereby all end strain of the mandrel against its bearings is prevented during and by the griping and holding of the blank.

"Lastly, I claim the spring discharging punch, constructed and arranged in such manner, that the same shall be compressed by the entrance of the blank between the griping jaws, and shall throw the blank out of the jaws the instant they relax their hold of it sufficiently; such pushing out depending upon such relaxation and the force of the spring, and being entirely independent of the motion of any other part of the machine."

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

Liquid and Unchangeable Glue. By M. de Dumoulin.

As this glue is very convenient for cabinet-makers, carpenters, and others, inasmuch as it is applied cold, and does not require heating, I give the method of preparing it to the public:—

Take of strong glue 1 kilogramme, (2·2 lbs. Av., 2·7 lbs. Troy,) dissolve it in 1 litre (1 quart) of water, in a glazed pot on a slow fire, or better still, over a water bath; stir carefully from time to time. When all the glue has melted, add little by little 200 grammes (6.5 oz. Troy) nitric acid, spec. grav. 1.33. This addition produces an effervescence due to the disengagement of nitrous acid. When all the acid is poured in, the vessel is removed from the fire and suffered to cool. I have preserved glue thus prepared for more than two years in an uncorked bottle, and during this time it underwent no change.—*Comptes Rendus de l'Acad. des Sciences, September*, 1852, *p.* 444.

For the Journal of the Franklin Institute.

Steam Logs of the Steamship "Arctic," belonging to the Collins Line of U. S. Mail Steamers between New York and Liverpool. By B. F. Isherwood, Chief Engineer, U. S. Navy.

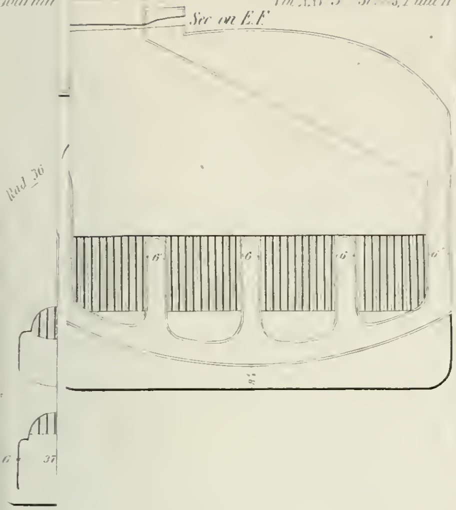
(*With a Plate.*)

By the kindness of Chief Engineer Daniel B. Martin, U. S. Navy, I have obtained copies of the steam logs of the *Arctic*, for the time he was Chief Engineer of her; and believing that the detailed performance of so celebrated a vessel would be generally acceptable, I have prepared them for the *Journal*, and added the dimensions of the hull, machinery, &c. From the same hands, I obtained the dimensions of the paddle wheels, and also a large number of indicator diagrams, showing exactly the power exerted by the engines, and the volume of steam used. The drawing of the boiler is from actual measurement, taken on board the vessel for this publication. It is believed, therefore, that the data and results here presented are as near the truth as it is possible to approximate, and even much nearer than is required for any practical purposes. It is possible that the dimensions of the hull may not be accurate to an inch, but I believe them to be correct.

HULL.—Length on deck,	286 feet.
Length between perpendiculars,	280 "
Beam on deck, extreme,	46 "
Depth below main deck,	24 "
Depth below spar deck,	32 "
Burthen,	2878 tons.
Mean draft of water on leaving port,	20 feet 3 inches.
" " arriving at port,	17 " 6 "
Average draft for the voyage,	19 "
Immersed amidship section at 19 feet draft,	685 square feet.
Displacement at 19 feet draft,	3724 tons.
" 17 feet 6 inches draft,	3368 "
" per inch of draft at 19 feet draft,	22 "
" " " 17 feet 6 inches draft,	20⅓ "
Angle of entrance at load line,	36°
" " launching line, (forward 8 feet 11 inches, aft 10 feet 5 inches,)	26°
" clearance at load line,	25°
" " launching line,	22°
Weight of the hull,	1380 tons.

The hull is braced by iron bars, 45 feet long, and 6 inches by 1 inch in section, placed 4 feet from centre to centre. The bars run in both directions, and cross at an angle of 45°; at each crossing they are riveted together.

ENGINES.—Two side lever condensing engines.	
Diameter of cylinders,	95 inches.
Stroke of pistons,	10 feet.
Space displacement of both pistons per stroke,	984·48 cubic feet.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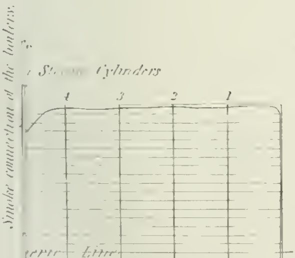
Smoke connection of the boilers.
Steam Cylinders
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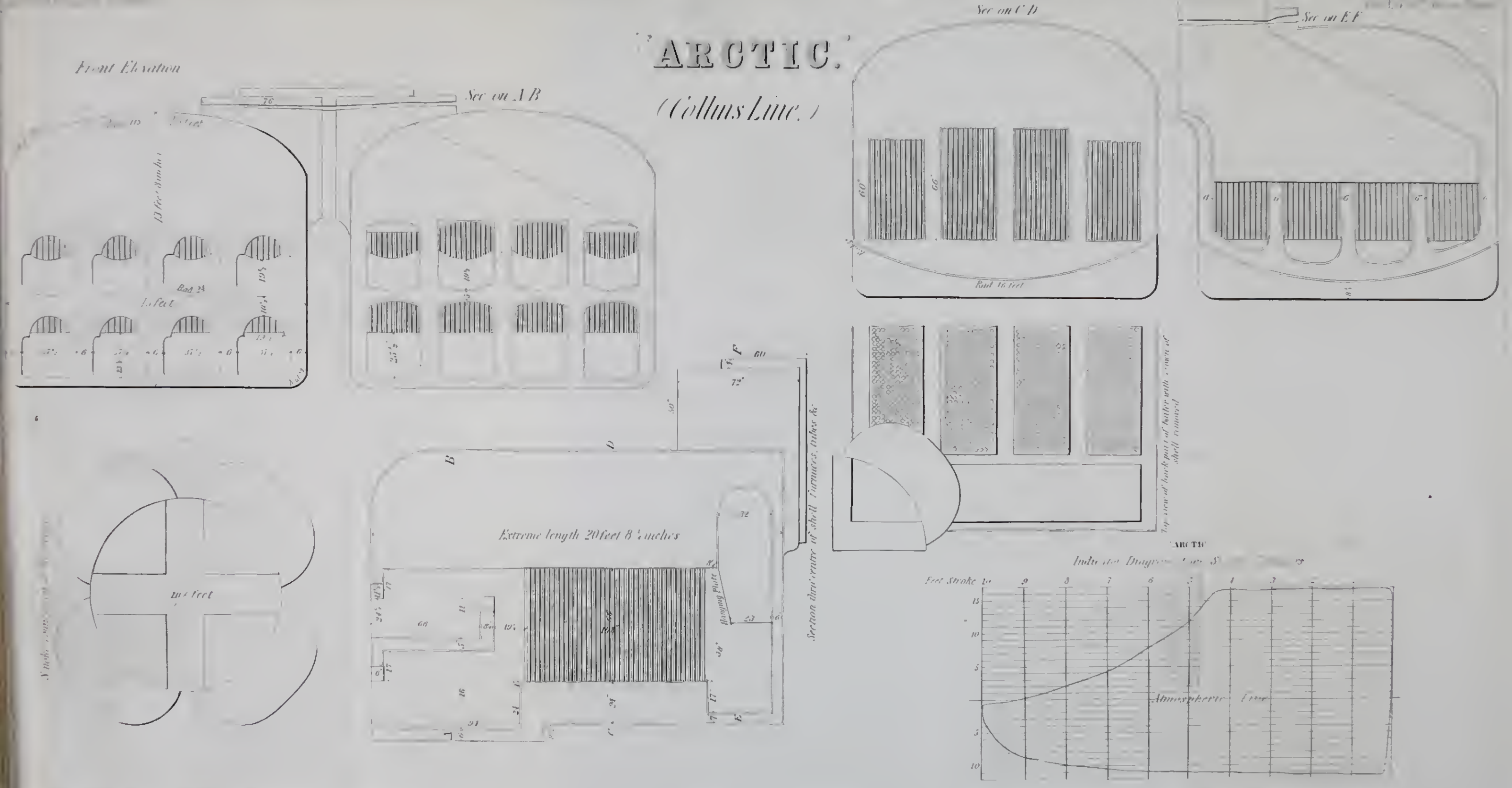
"ARCTIC."

(Collins Line.)



Paddle Wheels.—Of the common radial kind.

Diameter from outside to outside of paddles, .	34 feet 5 inches.
Length of paddle, . . .	11 " 6 "
Width " . . .	21½ "
Immersion of lower edge of paddle at 19 feet draft,	6 " 6 "
Number of paddles in one wheel, . .	36.
" " in water in one wheel, .	10.
Area of two paddles, . . .	41·208 sq. feet.
Area of all immersed paddle surface, .	412·08 "
Proportion of the area of two paddles to area of immersed amidship section of hull, . . .	1·000 to 16·623.
Proportion of the area of all immersed paddle surface to area of immersed amidship section of hull, .	1·000 to 1·662.

Boilers, (*Plate II.*)—Four iron boilers, with vertical tubes. The water is contained within and the fire is applied without the tubes. The boilers are placed in pairs back to back, with one smoke chimney in common; each pair has its own fire room. The forward and after pair are alike, except in breadth and number of tubes; each forward boiler being 14 feet broad, and containing 1332 tubes; and each after boiler being 15 feet broad, and containing 1480 tubes; making a total of 5624 tubes in the four boilers. These tubes are of iron, and 2 inches in external diameter; 2812 are 5 feet long, and 2812 are 4 feet 6 inches long. Distance in clear between tubes lengthways the boiler, 0·944 inch; crossways the boilers, 1·591 inch.

Length of each boiler, . .	20 feet 7 inches.	
Breadth of each forward boiler, . .	14 "	
" " after " . .	15 "	
Height of each boiler, exclusive of steam chimney, .	13 " 8 "	
Area of heating surface in the furnaces of the two forward boilers,	1204	square feet.
" " tubes "	7323	"
" " tube boxes "	500	"
" " smoke connexions "	263	"
" " furnaces of the two after boilers,	1242	"
" " tubes "	8137	"
" " tube boxes "	538	"
" " smoke connexions "	277	"
Total heating surface in the four boilers, .	19,484	"
Area of grate surface in the two forward boilers,	279·555	"
" " after " .	308·333	"
Total area of grate surface in the four boilers, .	587·889	"
Aggregate cross area of the spaces between the tubes in the two forward boilers,	55·685	"
" " " " after boilers,	61·250	"
Total aggregate cross area of the spaces between the tubes in the four boilers, . .	116·935	"
Aggregate cross area beneath the hanging plate at back of boiler in the forward boilers,	83·000	"
" " " " after "	92·000	"
Total " " " " four "	175·000	"
Cross area of the smoke chimney, . .	78·510	"
Height of the smoke chimney above the grates, .	75 feet.	
Capacity of the steam room in the four boilers, .	4350 cubic feet.	
Weight of sea water contained in four boilers, by calculation,	392,300 pounds.	

Proportions.—Heating to grate surface, .	33·142 to 1·000
Grate surface to aggregate cross area of spaces between tubes,	5·028 "
" " " beneath the hanging plate,	3·359 "
" to cross area of smoke chimney, .	7·485 "

Seventh Voyage from New York to Liverpool.

Date.	Average steam pressure in boiler per sq. in. above atmosphere in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Dec. 24, '51.	11·0	12·32	15160	20 30	65	227	40° 21′	69° 28′	
" 22, "	11·7	12·66	18039	23 45	72	274	42 02	63 52	
" 23, "	15·0	13·31	18835	23 35	91	247	44 31	59 39	
" 24, "	15·0	13·73	19426	23 35	91	290	45 58	52 56	
" 25, "	14·4	11·75	16414	23 17	81	232	47 51	48 06	
" 26, "	14·0	11·91	16734	23 25	83	253	49 31	42 26	
" 27, "	12·5	12·12	17093	23 30	85	272	51 34	36 14	
" 28, "	13·0	11·29	15976	23 35	80	232	51 58	30 08	
" 29, "	11·3	13·10	18450	23 28	77	271	52 12	22 52	
" 30, "	13·0	15·05	21299	23 35	89	301	51 20	15 03	
" 31, "	12·7	15·25	21312	23 18	82	294	55 55	7 36	
Jan. 1, '52.	13·3	16·20	17208	17 42	57	237			
Totals,			215946	273 15	953	3130			
Means,	13·3	13·172			7812lb. per. hr.	11·455 per h'r.			

Seventh Voyage from Liverpool to New York.

Jan. 8, '52.	14·1	10·19	15508	25 22	75	194			
" 9, "	13·6	9·80	14332	24 22	56	185	51° 17	12 23	
" 10, "	14·3	11·57	16976	24 27	73	258	51 38	19 15	
" 11, "	15·3	10·92	15891	24 15	78	177	51 25	24 02	
" 12, "	15·0	11·50	16764	24 19	76	244	50 46	29 43	
" 13, "	15·4	13·00	19005	24 23	84	264	50 06	36 30	
" 14, "	10·4	8·36	12264	24 27	64	115	49 00	38 51	
" 15, "	13·3	11 90	17133	24 00	74	209	47 40	43 36	
" 16, "	16·7	14·26	20807	24 19	86	295	45 54	50 00	
" 17, "	15·7	13·91	20310	24 20	85	252	45 10	56 02	
" 18, "	15·4	11·72	17132	24 22	77	184	44 19	60 15	Arriv'd and stopped off the Light Ship at midnight, losing 4½hs
" 19, "	16·7	15·22	22228	24 20	75	307	41 51	66 11	
" 20, "	15·1	13·29	19500	24 28	70	243	40 22	70 57	
" 21, "	15·0	15·90	13351	14 00	57	166			
Totals,				331 24	1030	3093			
Means,	14·7	12·131			6962lb. per h'r.	9·333 per h'r.			

Eighth Voyage from New York to Liverpool.

DATE, 1852.	Av. steam pres. in boil. per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made per min. (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Feb. 8	17·0	14·42	20550	23 45	85	300	40° 46′	67° 55	Mod fair wind & sea
" 9	16·7	14·30	20167	23 30	75	310	42 22	61 34	Mod. wind & sea on qr
" 10	17·5	15·35	21704	23 34	80	325	45 15	54 34	" " "
" 11	17·5	15·90	22419	23 30	88	331	46 55	47 22	" " "
" 12	17·0	15·84	22254	23 25	89	336	49 28	39 56	" " "
" 13	16·1	15·34	21497	23 21	89	238	50 52	34 10	Heavy sea and fresh wind on quarter.
" 14	17·0	16·44	23104	23 25	92	316	51 02	25 47	" " "
" 15	17·0	16·72	23440	23 23	90	307	51 00	17 39	" " "
" 16	16·7	16·57	23237	23 23	91	301	Cape Clear, 1 mile.		" " "
" 17	16·5	16·08	22594	21 25	87	295			Ship rolling badly, and engines racing.
Totals,			220966	232 41	866	3059			
Means,	16·9	15·828			8337lb. per h'r.	13·146 per h'r.			

Eighth Voyage from Liverpool to New York.

Feb. 26	17·5	13·46	18575	23 00	80	290			
" 27	17·0	13·46	19653	24 20	85	303	51° 20′	17° 18′	Fair weather: sail set.
" 28	17·1	13·70	20238	24 37	94	306	50 58	25 21	Wind ab'm , ship rol'g
" 29	17·0	13·82	20306	24 30	94	299	50 02	32 56	" " "
Mar. 1	16·6	12·57	18258	24 13	88	262	48 42	39 17	Strong h'd wind & sea
" 2	14·8	9·72	14184	24 20	71	136	48 02	42 31	Strong gale ahead. and head sea.
" 3	15·5	10·58	15319	24 08	75	186	46 46	46 56	" " "
" 4	16·7	12·22	17727	24 10	86	202	45 34	51 12	Moderate " "
" 5	17·2	14·32	20813	24 14	92	256	43 59	56 48	" " "
" 6	16·5	15·03	21972	24 22	89	315	42 30	63 36	Moderate variable wind: smooth sea.
" 7	17·0	15·34	22400	24 20	91	312	41 37	70 02	Mod variable wind smooth ses; sail set part of the time.
" 8	16·0	15·00	15707	17 30	65	219			
Totals,			225152	283·44	1010	3086			
Means,	16·6	13·226			7974lb. per h'r.	10·877 per h'r.			

Ninth Voyage from New York to Liverpool.

DATE. 1852.	Average steam pressure in boiler per sq. in. above atmosphere in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Mar. 21	17·0	13·82	19480	23 30	85	300	40° 53′	68° 00′	Wind moder. and fair.
“ 22	17·8	14·37	20256	23 29	90	308	40 23	61 20	“ “ “
“ 23	17·5	14·26	20107	23 30	98	280	44 00	55 23	Wind light ahead: heavy head sea
“ 24	17·0	14·08	19843	23 29	90	270	45 41	42 27	Strong “ “ “ “
“ 25	17·5	14·05	19818	23 30	83	268	47 24	43 35	“ “ “ “ “
“ 26	17·3	14·32	20232	23 33	82	260	49 38	38 02	“ “ “ “ “
“ 27	17·2	15·02	21173	23 30	90	282	50 56	30 55	Fresh “ “ “ “
“ 28	16·9	13·19	18577	23 28	77	228	51 00	24 59	Mod gale ah'd “ “
“ 29	16·5	13·48	19005	23 30	69	204	50 52	19 38	Strong gale ah'd “ “
“ 30	16·5	15·93	22371	23 24	77	297	51 01	11 05	Mod h'd wind, h'vy sea
“ 31	17·0	17·09	23819	23 13	83	307	51 01	5 05	“ “ h'vy sea ab'm
April 1	18·0	18·62	6555	5 52	33	79			“ “ Smooth sea
Totals,			231236	263 58	957	3083			
Means,	17·1	14·600			8121lb. per h'r.	11·680 per h'r.			

Ninth Voyage from Liverpool to New York.

DATE. 1852.	Average steam pressure in boiler per sq. in. above atmosphere in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
April 8	17·7	13·90	19152	23 00	85	303	*	*	
“ 9	17·5	13·80	20316	24 32	82	305	51° 20′	17° 43′	Fresh br. aft, mod sea.
“ 10	17·1	13·43	19737	24 30	85	302	50 42	25 39	Fresh br. ab'm h'vy “
“ 11	17·4	13·90	20361	24 25	87	274	49 41	32 35	Light wind ah'd “ “
“ 12	17·5	14·18	20730	24 22	88	260	48 14	38 50	Mod wind ah'd mod “
“ 13	17·2	13·24	19410	24 26	84	243	46 56	41 24	H'vy wind ah'd hvy “
“ 14	17·0	12·99	19021	24 25	74	258	45 39	50 18	Mod wind ah'd “ “
“ 15	17·6	15·35	22557	24 30	87	325	44 06	57 17	Fresh fair wind mod “
“ 16	17·5	16·02	23552	24 30	89	330	42 11	64 23	Mod fair wind, “ “
“ 17	17·0	15·00	21997	24 28	86	272	40 07	69 47	Strong gale ah'd “ “
“ 18	17·5	17·00	16320	16 00	59	218			
Totals,			223153	259 08	906	3090			
Means,	17·3	14·353			7832lb. per h'r.	11·924 per h'r.			

*Seven miles West of Cape Clear; from the Rock to Cape Clear, 22 hs. 29 min.

Tenth Voyage from New York to Liverpool.

DATE 1852.	Average steam pressure in boiler per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude	REMARKS.
May 2	16·0	13·44	15850	19 39	80	225	41° 34′	69° 40′	Lost 4 hours by fog.
“ 3	16·0	13·01	18340	23 30	81	276	41 48	63 49	Light head wind.
“ 4	17·0	14·08	19856	23 30	87	268	42 30	58 14	“ “ “ mod sea
“ 5	17·0	14·49	20356	23 25	87	298	46 02	52 11	“ “ “ “
“ 6	16·9	14·96	21143	23 33	89	298	48 16	45 47	“ fair “ “
“ 7	16·6	14·74	20819	23 32	89	306	50 25	34 44	Fresh “ “ “
“ 8	16·9	14·97	20990	23 22	85	298	51 04	30 56	“ “ “ “
“ 9	16·9	15·62	21907	23 22	87	315	51 05	22 35	“ “ “ “
“ 10	16·9	15·59	21819	23 21	91	302	50 47	14 37	“ “ “ “
“ 11	16·2	15·91	22357	23 25	86	310			At 8 h 44 m abreast of Holyhead, thence slow, stopping at times, and at 3h 9m passed the Rock.
“ 12		15·98	14273	14 53	58	185			
Totals,			217740	245 32	920	3081			
Means,	16·6	14·780			8393lb. per h'r.	12·556 per h'r.			

Tenth Voyage from Liverpool to New York.

May 20	16·5	13·61	20830	25 30	85	320	51° 22′	10° 13′	Light w'd abm mod sea
“ 21	17·0	13·35	19535	24 24	77	300	50 49	18 04	“ “ “ “
“ 22	16·8	14·32	21096	21 33	79	318	49 54	26 05	“ “ “ “
“ 23	17·1	14·85	21749	24 25	79	310	49 28	34 08	Strong h'd w'd h'vy “
“ 24	17·4	14·52	21394	24 33	81	288	48 43	41 23	“ “ “ “
“ 25	17·0	14·70	21446	24 19	84	280	47 50	48 14	Mod gale ah'd “ “
“ 26	17·2	14·12	20608	24 20	80	262	45 56	53 49	Strong gale ah'd “ “
“ 27	16·6	13·64	19805	24 12	80	241	44 16	58 58	Mod fair wind, mod. “
“ 28	16·7	16·10	23510	24 20	84	322	41 24	65 07	Calm
“ 29	16·4	16·44	23968	24 18	84	336	40 16	72 05	Ar'vd off Light Ship 6 p m: weather foggy: laid to till next morn'g, and arrived at dock at 7½ hour.
“ 30	16·7	18·13	8703	8 00	50	112			
Totals,			222644	252 54	863	3089			
Means,	16·9	14·672			7644lb. per h'r.	12·214 per h'r.			

Eleventh Voyage from New York to Liverpool.

DATE. 1852.	Average steam pressure in boiler per square inch above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
June 13	14·0	12·65	17817	23 28	80	259	40° 53′	68° 43′	Fair wind; smooth sea
“ 14	16·0	13·31	18775	23 30	82	278	42 10	62 42	Light wind “ “
“ 15	16·2	13·50	19130	23 37	86	263	44 02	57 23	Light head w'd “ “
“ 16	16·7	14·33	20228	23 32	90	283	45 55	51 23	“ “ “ “
“ 17	14·6	13·87	19636	23 35	90	276	48 12	43 34	“ “ “ “
“ 18	15·4	14·76	20914	23 37	92	325	50 02	37 39	“ “ “ “
“ 19	14·0	14·05	19858	23 33	91	321	51 11	29 39	Light wind abm mod “
“ 20	13·8	14·41	20193	23 21	89	300	51 06	21 49	Fresh fair wind “ “
“ 21	15·4	14·82	20859	23 27	88	300	51 06	14 10	Light var. “ “ “
“ 22	15·6	15·04	21160	23 27	90	306			Fresh w'd ab'm “ “
“ 23	14·0	15·03	12525	13 53	45	181			At 1½hs 56m pass'd the Rock Light
Totals,			211095	249 00	923	3092			
Means,	15·1	14·130			8303lb. per h'r.	12·418 per h'r.			

Eleventh Voyage from Liverpool to New York.

DATE. 1852.	Average steam pressure in boiler per square inch above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
July 1	16·0	12·19	19324	26 25	85	258	55° 22′	8° 40′	Gale ahead; heavy sea
“ 2	17·0	11·57	16851	24 17	86	222	55 10	15 06	“ “ “ “
“ 3	17·0	13·00	19056	24 26	88	269	54 23	22 50	“ “ “ “
“ 4	17·1	12·84	18826	24 26	85	248	53 18	29 26	“ “ “ “
“ 5	16·7	13·03	19118	24 27	89	257	51 34	36 00	“ “ “ “
“ 6	16·6	13·56	19865	24 25	86	258	50 02	42 18	Strong br. ah'd “ “
“ 7	16·9	14·40	21044	24 21	89	314	47 56	49 34	Mod. br. ah'd mod. “
“ 8	16·7	15·03	22042	24 27	91	336	45 24	56 44	Light br ah'd, “ “
“ 9	17·0	15·55	22729	24 22	94	274	43 28	62 24	“ “ “ “
“ 10	16·2	15·76	23069	24 24	95	304	40 38	67 52	Mod br. ah'd, “ “
“ 11	14·0	14·47	21096	22 18	85	278			Ariv'd at Sandy Hook in the morn; weather very foggy; at noon broke away, & pass'd the Hook; at 1½h 20m ran ashore at the Narrows; at 2hs arrived at dock.
Totals,			223020	268 18	973	3018			
Means,	16·5	13·854			8124lb. per h'r.	11·249 per h'r.			

Twelfth Voyage from New York to Liverpool.

DATE. 1852.	Average steam pressure in boilers per square inch above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Aug. 8	15·0	12·00	17060	23 42	75	257	40° 41′	68° 50′	Light wnd: smooth sea
" 9	15·5	13·12	18502	23 30	85	265	42 08	63 20	" " "
" 10	16·2	13·41	18966	23 34	84	271	44 01	57 45	" " "
" 11	14·4	13·11	18622	23 40	81	268	46 00	52 05	" " "
" 12	15·2	13·67	19256	23 28	87	269	48 29	46 31	" " "
" 13	15·0	14·01	19724	23 28	87	280	50 28	40 07	" " "
" 14	14·5	14·56	20424	23 31	91	288	51 22	32 40	" " "
" 15	14·2	14·37	20111	23 19	92	298	51 08	24 50	" " "
" 16	13·8	14·51	20490	23 32	90	302	51 00	16 53	" " "
" 17	13·0	15·12	21284	23 28	89	278			" " "
" 18	14·0	15·21	21038	23 3	88	300			" " "
Totals,			215477	258 15	949	3076			
Means,	14·6	13·906			8231lb. per h'r.	11·911 per h'r.			

Twelfth Voyage from Liverpool to New York.

Aug. 26	17·0	13·63	16352	20 00	75	247			Light wnd; smooth sea
" 27	15·0	12·21	17850	24 21	70	258	50° 50′	14° 56′	Mod head wind mod "
" 28	16·0	13·13	19233	24 25	87	238	51 12	21 13	Strong h'd wind, h'y "
" 29	16·7	13·55	19839	24 24	90	264	50 43	28 11	" " " " "
" 30	16·3	14·37	20987	24 21	94	301	49 59	35 51	Mod " " mod "
" 31	16·0	12·29	17923	24 19	90	203	49 09	40 58	Gale ahead heavy "
Sept. 1	14·0	11·68	17025	24 18	82	200	47 26	45 14	" " " "
" 2	15·2	14·31	20883	24 19	87	292	45 47	51 54	Mod wind abm mod "
" 3	14·0	15·25	22281	24 21	90	314	43 50	58 42	Mod wind ah'd mod "
" 4	13·0	15·23	22239	24 20	86	310	41 54	65 15	" " " "
" 5	10·3	13·95	20376	24 21	86	296	40 36	71 26	" " " "
" 6	9·9	16·16	8723	9 00	36	138			" " " "
Totals,			223711	272 29	973	3061			
Means,	14·6	13·683			7998lb. per h'r.	11·233 per h'r.			

Summary of the Steam Log. From New York to Liverpool.

Voyage.	DATE.	TOTALS.				MEANS.			
		No. of double strokes of piston made.	Time from dock to dock; Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Steam pressure in boilers per square inch above atmosphere in pounds.	Number of double strokes of piston made per min.	Coal consumed per hour in pounds.	Speed per hour in geographical miles.
7th.	December, 1851.	215946	273 15	953	3130	13·3	13·172	7812	11·455
8th.	February, 1852.	220966	232 41	866	3059	16·9	15·828	8337	13·146
9th.	March, "	231236	263 58	957	3083	17·1	14·600	8121	11·680
10th.	May, "	217740	245 32	920	3081	16·6	14·780	8393	12·556
11th.	June, "	211095	249 00	923	3092	15·1	14·130	8303	12·418
12th.	August, "	215477	258 15	949	3076	14·6	13·906	8231	11·911
	Means,	218743	253 47	928	3087	15·6	14·403	8199$\frac{1}{2}$	12·194

From Liverpool to New York.

7th.	January, 1852.	241204	331 24	1030	3093	14·7	12·131	6962	9·333
8th.	Feb & Mar "	225152	283 44	1010	3086	16·6	13·226	7974	10·877
9th.	April, "	223153	259 08	906	3090	17·3	14·353	7832	11·924
10th.	May, "	222644	252 51	863	3089	16·9	14·672	7644	12·214
11th.	July, "	223020	268 18	973	3018	16·5	13·854	8124	11·249
12th,	August, "	223711	272 29	973	3061	14·6	13·683	7998	11·233
	Means,	226481	277 59	959$\frac{1}{6}$	3073	16·1	13·653	7755$\frac{2}{3}$	11·138
	Means of means,	222612	265 53	943$\frac{7}{12}$	3080	15·85	14·028	7978	11·666

Remarks on the Steam Log.

An inspection of the preceding "summary," shows the voyages from New York to Liverpool to be on an average 24 hours and 12 minutes shorter than the average of the voyages from Liverpool to New York. The length of the route or distance run can be taken to be the same in both directions, the means by observation differing only 14 miles, or less than half of one per cent. of the lesser distance; but the voyage from New York to Liverpool required on an average 7738 less revolutions of the wheels, than the average voyage from Liverpool to New York. In the latter case, therefore, the slip of the wheels was 2·99 per cent. more than in the former; the slip in the latter case being 20·86 per cent., and in the former case 17·87 per cent. The consumption of coal also is less in the voyages from New York to Liverpool, by an average of 31$\frac{1}{6}$ tons; but the consumption of coal per hour is greater by 221$\frac{1}{3}$ pounds.

The difference in the performance of the vessel for the easterly and westerly passages, is probably caused by the greater prevalence of westerly winds. The distance from the Battery, New York, to Liverpool, by Mercator and great circle, is 3023 geographical miles; by Mercator, 3084 geographical miles. The mean, therefore, of 3080 miles, made by the *Arctic*, shows very excellent navigation.

Coal.—The coal used in the voyages from New York to Liverpool was the Pennsylvania anthracite; in the voyages from Liverpool to New York, the Welch coal of similar chemical composition.

Evaporation by the Pennsylvania Anthracite.—The cut-off used in the *Arctic* was Stillman & Allen's; it was adjustable, and frequently changed within short limits, as circumstances of weather, quality of fuel, &c., required; the object being to run with a *wide throttle* and maximum boiler pressure. The average point of cutting off was four feet four inches from the commencement of the stroke, and the steam space comprised between the cut-off valves and pistons of the two cylinders, at one end, is, as near as I have been able to obtain it, 25 cubic feet, which I believe is exact. This would make the bulk of steam used in both engines per stroke 451·608 cubic feet. The number of double strokes of piston per minute was 14·403, making the bulk of steam used per minute 13009·02 cubic feet. To this must be added the loss by *blowing off* in sufficient quantities to maintain the sea water in the boilers at $1\frac{3}{4}$ the natural concentration. From the data given in Regnault's experiments, this loss would be as follows—the temperature of the feed water being maintained at 110° Fah., and the average steam pressure in the boilers being 15·6 pounds per square inch above atmosphere, or 30·3 pounds total pressure. The total heat of steam of this pressure is 1158·34° Fah., of which 110° were furnished by the feed, leaving 1048·34° to be furnished by the fuel to the three parts of the water evaporated. The temperature of steam of 30·3 pounds being 252·2° F., and the temperature of the feed 110° F., there was (252·2 — 110 =) 142·2° F. to be supplied by the fuel to the four parts blown out; and

$$\begin{array}{rl} 1048{\cdot}34 \times 3 = & 3145{\cdot}02 \\ 142{\cdot}20 \times 4 = & 568{\cdot}80 \\ \hline \text{and} & 3713{\cdot}82^\circ \text{ equals total heat,} \end{array}$$

supplied by fuel, of which 568·80° is 15·32 per cent., and is lost by *blowing out*, leaving 84·68 per cent. of the fuel utilized in evaporation, and if 84·68 per cent. evaporated 13009·02 cubic feet per hour, 100 per cent. would evaporate 15362·57 cubic feet. The mean of a large number of indicator diagrams gives the initial cylinder pressure 2 pounds less than the boiler pressure, making it 28·3 pounds per square inch, and the relative of bulks of steam of this pressure and the water from which it is generated is as 932 to 1: — $\frac{15362{\cdot}57}{932} = 16{\cdot}4834$, which, taking the weight of distilled water at $62\frac{1}{2}$ pounds per cubic foot, becomes 1030·2125 pounds of steam evaporated per minute, or 61812·75 pounds per hour by $8199\frac{1}{2}$ pounds of coal, *which is 7·539 pounds of steam evaporated per hour from sea water of one and three-fourths the natural concentration, by one pound of Pennsylvania anthracite, with temperature of feed water 110° F.*

Evaporation by the Welch Coal.—Proceeding in the same manner with the Welch coal, with the same point of cutting off, and the same difference of two pounds between the initial cylinder and boiler pressure, and making the necessary alterations for the different total and sensible heats of the slightly different steam pressure; there results *an evaporation of 7·653 pounds of steam per hour from sea water of one and three-fourths the natural concentration, by one pound of Welch coal, with temperature of feed water* 110° *F.*

The results from the Anthracite and Welch coals agreeing so very closely, it may be concluded the two fuels are of equal value as generators of steam, an agreement we should also be entitled to expect from their closely resembling chemical constitutions, which compare as follows—Professor Walter R. Johnson being the authority for the Anthracite, and the British Commission of De la Beche and Playfair for the Welch coals from the northern part of Wales:

	Pennsylvania Anthracite. Mean of 9 analyses made on Coal from 6 localities.	Welch Coals. Mean of analyses made on Coal from 14 localities.
Fixed Carbon, . .	88·540	88·882
Volatile matter, including moisture,	5·170	7·279
Sulphur, ...	0·052	0·912
Earthy matter, . . .	6·510	3·095
Total, ...	100·272	100·168
Pounds of steam evaporated by 1 lb. of coal, under similar circumstances, with same boilers, engineer, &c., being the mean results from a combustion of 5568 tons of Anthracite and 5755 tons of Welch coals, .	7·539	7·653

PERFORMANCE.—The mean performance of the *Arctic* for the six voyages eastwardly and the six voyages westwardly, being the average of 3190 hours and 38 minutes steaming, is as follows, viz:

Speed of the vessel per hour in geographical miles of 6082⅔ feet,	11·666
" " " statute miles of 5280 feet,	13·439
Revolutions of the wheels per minute, . . .	14·028
Slip of the centre of pressure of the paddles, . .	19·32 per cent.
Oblique action of the paddles, ...	21·50 "
Steam pressure in boilers per square inch above atmosphere,	15·85 pounds.
Initial steam pressure in cylinders per sq. in. " .	13·85 "
Point of cutting off from commencement of stroke, . .	4 feet 4 inches.
Mean effective pressure per square inch of pistons, .	19 pounds.
Horses power developed by the engines, . .	2290
Consumption of coal per hour, ...	7978 pounds.
Consumption of coal per 24 hours in tons of 2240 lbs.	85·48 tons.
Consumption of coal per square foot of grate surface per hour,	13·571 pounds.

INDICATOR DIAGRAM.—The accompanying indicator diagram, (*Plate II.*) is selected from a large number, to show the average performance of the engines, setting of the valves, &c. It was taken from the top of the starboard cylinder, the engines making 14½ double strokes of piston per minute. Steam pressure in boilers above atmosphere, 18½ pounds per square inch. Temperature of hot well 113° Fah. Throttle wide.

For the Journal of the Franklin Institute.

American Porcelain.

It is a matter of some singularity, that in the rapid advance of our manufactures, so little attention has been paid among us to a branch of so much importance as the manufacture of porcelain, an article of which large quantities are used by our people, especially the plain ware, and the raw materials for making which are very abundant and of excellent quality. We see that recently a manufacture of this ware has been established in Connecticut, but we have not as yet seen any of their products, and cannot, therefore, speak of their quality; but we take advantage of this as a fitting opportunity to record the previous establishment of such a manufactory in our own City, which for a time was very successful, both in making a very excellent article of plain porcelain, and in introducing it into extensive use; but finally came to an end, and is now almost entirely forgotten, even in the place where it formerly existed. The following letter will be found interesting to those of our readers who concern themselves with the history of American manufactures.

Professor Frazer:

Dear Sir:—At your request, I give you with pleasure a few of the particulars of the first manufacturer of American porcelain. My brother, William Ellis Tucker, son of Benjamin Tucker, of the City of Philadelphia, was the first to make porcelain in the United States. My father had a china store on Market street, and in the year 1816 he built William a kiln in the yard back of the store, when William commenced painting upon the white ware in the store, and burning it in the kiln; after which he commenced trying experiments with different clays, to see if he could not make the ware; and finally he succeeded in producing an opaque ware, called queensware. He then commenced trying experiments with feldspar and kaolin, to make porcelain; and after many experiments and much labor, he was successful in making a very beautiful porcelain in a small way. He then rented of the City Corporation the old Water Works, at the north-west corner of Schuylkill Front and Chesnut streets. I do not remember the year, but it was prior to the year 1826. On the 23d of October, 1826, he purchased four acres of land, containing a feldspar quarry, and erected a large glazing kiln, enamelling kiln, mills, &c.; but he found it a very different thing to produce china on a large scale. He had kiln after kiln spoiled, until he almost gave up in despair; but with a perseverance that few others had, he continued until his efforts were crowned with success. In the year 1827, he received a silver medal from the Franklin Institute of the State of Pennsylvania, and also in the year 1831, he received one from the Institute of New York, both of which I now have.

In the year 1828, I commenced to learn the different branches of the business, which I did by serving several years apprenticeship to the same. My brother, William Ellis Tucker, died on the 22d of August, 1832, before which time he had, in connexion with Judge Hemphill, erected a large china factory at the south-west corner of Schuylkill Sixth and Chesnut streets, the store rooms of which were filled with porcelain of his manufacture.

After the death of my brother (William Ellis), Judge Hemphill and myself continued the manufacture of porcelain for some years, until he sold out his interest to a company of eastern gentlemen, who intended to carry on the business on a large scale; but just at that time they were unfortunate in their other operations, and therefore were unable to do anything for the china factory.

On the 2d of October, 1837, I rented the entire factory, with all the fixtures, &c., and continued the business for some time, until I filled a store with porcelain of my own manufacture, which I had taken in Chesnut street, between Seventh and Eighth. I then discontinued the manufacturing of porcelain, and commenced ordering from Europe, which I have regretted ever since.

I have now given you in a rough way the rise and fall of American porcelain at Philadelphia.

With much respect, I remain yours, &c.

THOMAS TUCKER.

Philadelphia, November 27, 1852.

Translated for the Journal of the Franklin Institute.

Memoir on the Consequences to be Deduced from the Experiments of M. REGNAULT, *on the Laws of the Compressibility of the Gases.* By M. AVOGADRO, (*from the Memoirs of the Academy of Sciences of Turin, 2d Series, Vol. XIII.*)

M. Regnault, in his Memoir *On the Compressibility of Elastic Fluids*, which is the eighth of the collection published by him in 1847, among those of the Academy of Sciences, Vol. XXI., (see *Journ. Frank. Inst.*, 3d Series, Vol. XVI, p. 190,) determined experimentally for atmospheric air, hydrogen gas, carbonic acid, and nitrogen, the values of the ratio of the density to the pressure in each of these aëriform fluids, taken at different densities. He found that expressing the pressure or elastic force by r, in metres of mercury, and designating by m, the density which corresponds to each pressure, taking as unity that which belongs to each gas, under a pressure of one metre of mercury, the value of $\frac{r}{m}$, which according to the assumed units must be one for the pressure of one metre, and according to the law of Mariotte, ought to remain constant for all pressures, is greater than one, and increases with the density m, for hydrogen; and on the contrary is less than one, and decreases with the increase in the density for atmospheric air, carbonic acid, and nitrogen. The experiments made by him on this point were at the densities, two, four, eight, and sixteen, and a common and constant temperature of 3° or 4° Cent. (37°·4 to 39°·2 Fahr.) In this elaborate memoir M. Avogadro discusses the various consequences which philosophers have sought to deduce from these experiments, and after examining the subject fully and carefully, sums up by the enumeration of the following conclusions, to which his reasoning leads:—

1. The law of the compressibility of a perfect gas, (that is, of one free from the influence exercised by the tendency to liquefaction in approaching the density at which this phenomenon takes place,) may be represented by an experimental formula of the form

$$a^{\sqrt[3]{\frac{r}{m}-1}}=m.$$

Where r indicates the pressure in metres of mercury; m, the corresponding density, the unit of density being that belonging to the gas, under a pressure of one metre of mercury; a being a constant for all the gases at a given temperature. This formula may be presented under the form

$$\sqrt[3]{\frac{r}{m}-1}=\frac{\log.\ m}{\log.\ a} \text{ or } \frac{r}{m}-1=\frac{(\log.\ m)^3}{(\log.\ a)^3}$$

According to this formula we have $\frac{r}{m}-1=1$, or $\frac{r}{m}=0$, and consequently the elastic pressure $r=0$, when the density is reduced to $m=\frac{1}{a}$ This formula ought to be substituted for the law of Mariotte, which, in the same notation, would be expressed by $\frac{r}{m}=1$, or $\frac{r}{m}-1=0$, to which the formula would be reduced by making $a=\infty$; consequently $\frac{1}{\log.\ a}=0$; that is, by supposing that the pressure only becomes nothing when the density becomes nothing—a supposition which M. A. shows in his memoir to be inconsistent with our physical theories.

2. The value of the constant a, in this formula, must vary with the temperature of the gas. For common temperatures, or more precisely when the temperature is 3 to 4 degrees above the melting point of ice, the value of a, calculated from the experiments of M. Regnault, is 9735·32, or nearly 10,000; hence employing the logarithms of the tables $\frac{1}{\log.\ a}=\frac{1}{4}$, and $\frac{1}{(\log.\ a)^3}=\frac{1}{64}$: so that the formula for that temperature, under the logarithmic form becomes

$$\frac{r}{m}-1=0{\cdot}015762\ \frac{(\log.\ m)^3}{64} \text{ or nearly } \frac{r}{m}-1,=(\log.\ m)^3$$

3. All the gases cease to be perfect, and present a value of $\frac{r}{m}$ less than that given by the preceding formula, when they reach a certain limit of density, which varies with the different gases, and which must also vary with the temperature to which the gases are reduced. For the temperature of 3 or 4 degrees (Cent.) above the melting point of ice, this

limit corresponds in hydrogen nearly to $m = 2$, that is, to a density double of that which the gas possesses under a pressure of a metre of mercury; in nitrogen gas, $m = 1{\cdot}25$, and in oxygen gas, so far as can be deduced from M. Regnault's experiments on the air, of which oxygen forms a part, $m = 1$, that is, to the density which it has under a pressure of one metre of mercury. For carbonic acid, and at the temperature indicated, this limit is found to correspond to $m = \frac{1}{4}$ nearly; so that the influence of the tendency to liquefaction begins to show itself in the law of compressibility of this gas, so soon as the density passes $\frac{1}{4}$ of that which it has under the pressure of one metre of mercury.

4. The diminution which the tendency to liquefaction produces in the gases, starting from the limit indicated, in the value of $\frac{r}{m} - 1$, which would be given for each value of m, by the formula for perfect gases, may be represented by an expression of the form $c\,(m - A)^{\frac{9}{8}}$ denoting by A the value of m, at which the influence of this tendency begins to show itself for each gas at the temperature at which it is taken, and by c, a coefficient, depending on the nature of each gas, which must also vary with the temperature.

At the temperature of 3 or 4 degrees (Cent.) above the melting point of ice, the value of this co-efficient is for hydrogen 0·0008465, for nitrogen 0·0017573, and for oxygen 0·003538; these numbers being deduced from the direct experiments of M. Regnault on hydrogen and nitrogen, and from these on the air, for oxygen.

Thus for these gases the complete formula for their compressibility would be :—

For hydrogen, $\frac{r}{m} - 1 = 0{\cdot}015762\,(\log. m)^3 - 0.00088465\,(m - 2)^{\frac{9}{8}}$

For nitrogen, $= 0{\cdot}015762\,(\log. m)^3 - 0.0017573\,(m - 1{\cdot}5)^{\frac{9}{8}}$

For oxygen, $= 0.015762\,(\log. m)^3 - 0.003538\,(m - 1)^{\frac{9}{8}}$

As to carbonic acid, in which the influence of the tendency to liquefaction begins to show itself at a density below that which it has under a pressure of one metre of mercury, this circumstance obliges us to modify even the positive part of the formula which supposes the gas perfect, and the complete formula for that gas, at the temperature indicated, may be put under the form

$$\frac{r}{\mu} - 1 = 0{\cdot}015762\,(\log. \mu)^3 - 0{\cdot}0074716\,(\mu - 0{\cdot}25)^{\frac{9}{8}}$$

where $\mu = 1{\cdot}0053\,m$; and 0·0074716 being the value of c deduced from the experiments of M. Regnault.

In all these formula the negative part, due to the influence of the tendency to liquefaction, disappears of itself, at the limit of the density beyond which this influence is shown for each of the gases, and must be suppressed for densities below this, when all the gases must follow the formula of perfect gases.

5. These formulæ give for the pressure r a maximum corresponding to a certain density, beyond which the gases could not sustain a pressure even equal to that which has been already applied to them, and at which, consequently, they must condense into liquids. This maximum of pressure is found to correspond for hydrogen to about the density of 357; for nitrogen, to 181; for oxygen, to 91; and for carbonic acid, to 44; always taking for the unit of density, that of each gas under a pressure of one metre of mercury; so that at these limits of densities respectively, these gases ought to be reduced to liquids, at the temperature of 3 or 4 degrees (Cent.) above the melting point of ice; and the pressure required for that, according to these same formulæ, would be 217 metres of mercury for hydrogen gas, 104 metres for nitrogen, 51 metres for oxygen, and 24 metres for carbonic acid; and this indication is found to be approximately verified for carbonic acid, the only one of these four gases which has heretofore been liquified at ordinary temperatures.—*Archives des Sciences Phys. et Nat., June, 1852, p. 126.*

Translated for the Journal of the Franklin Institute.

On the Purification of Iron and Coke from Sulphur.

At the meeting of the French Academy of Sciences, on the 27th September, M. Chevreul read a note upon this subject from M. Calvert, of which the following extracts will give the substance, which appears to be worthy of the attention of our iron manufacturers:—"The sulphur which the iron contains rarely comes from the ore, but from the combustible employed. After many trials, I have discovered that the chloride of sodium, applied in a certain way, and in proper proportions, will decompose the sulphurets present, whether in the ore or in the fuel. This process, which I have employed in three furnaces—two in Scotland and one in Wales—has given me very satisfactory results. In the iron thus obtained the crystals are not found, and the metal acquires a long and very tenacious fibre. I have not been able to ascertain the exact ratio of the tenacities of the purified and unpurified iron, but I have determined the comparative resistance of the two cast irons. I took bars of the irons carefully shaped, having one square inch cross-section and five feet long; I placed them on supports, distant 4 feet 6 inches from each other, and applied on the centre of the bars a gradual pressure, by means of a screw, until the bars broke. The breaking weights were—

Unpurified—	487 lbs.	Purified—	556 lbs.
"	456 "	"	525 "
"	487 "	"	544 "
"	470 "	"	562 "
		"	569 "
		"	544 "

These irons were analysed, and the unpurified iron contained 0·006 sulphur, while the purified contained only 0·001.

I applied the same process upon an extensive railroad in England, in the manufacture of coke, and obtained a great economy from the non-destruction of the fire-boxes and tubes by the sulphur. I also obtained at Manchester very satisfactory results, by employing coke thus prepared for the re-melting of iron in cubilot furnaces; the purified bars bearing 528 lbs., while the unpurified broke with 514 lbs.

For the Journal of the Franklin Institute.

Salt of Western Pennsylvania. By JAMES C. BOOTH and T. H. GARRETT.

The value of common salt for dairy purposes, preserving food, and for general use, and the singularly advantageous position of the salt springs or wells of Western Pennsylvania, issuing at the mouths of coal mines, led us to investigate the relative purity of some of the salt manufactured there, in comparison with foreign salt imported and largely employed on the coast. We subjected to analysis, Turk's Island, Liverpool ground Rock, and two samples of salt, coarse and fine, kindly furnished us by Mr. Lewis Peterson, of Salina Farm, near Tarentum, Pennsylvania, where and by whom the two samples were manufactured.

The following tabular arrangement of the results of analysis give a clearer comparative view of their relative purity and value:

	Chloride of Sodium.	Chloride of Magnesium.	Chloride of Calcium.	Sulphate of Magnesia.	Sulphate of Lime.
Coarse, Tarentum, Penn.,	97·89	1·00	1·11	none.	trace.
Fine, " " "	98·87	0·51	0·62	none.	trace.
Liverpool ground Rock,	98·55	0·08	none.	0·16	1·21
Turk's Island, . .	93·85	3·47	none.	none.	2·68

Beside these, the Turk's Island contains a little sand, of which the others only contain traces. The difference between them is evidently that the impurities in the Pennsylvania salt are chlorides, and in the others, sulphates of lime and magnesia. Since the chlorides are easily removed by washing, it is evident that the Pennsylvania salt might be brought to a state of absolute purity, if it were desirable or necessary. The salt manufactured by Mr. Lewis Peterson, bears a close comparison with the Liverpool ground Rock, and his fine variety surpasses it. Both of his varieties are 4 or 5 per cent. purer than Turk's Island salt.

Hints on the Principles which should regulate the Forms of Ships and Boats; derived from original Experiments. By MR. WILLIAM BLAND, *of Sittingbourne, Kent.*[*]

Continued from Vol. xxiv., page 420.

CHAPTER XX.—CONCLUSION.

Since curves must be substituted for the straight line in the forms of the bottoms of all vessels of speed, as proved (see experiments 33, &c., chapter VII.), and in consequence a keel is indispensable, the midship section, but particularly the parts fore and aft of the same, will partake more or less of the elliptic and angle shape.

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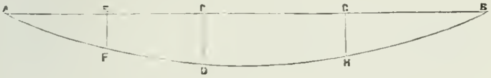
[*] From the London Civil Engineer and Architect's Journal, November, 1852.

From experiments made subsequent to those already given in chapter XI., but not entered, and for the purpose of determining the perpendicular depth of the under-part of the keel at midships, from the load waterline of models with curved bottoms, it appeared that the depth to cause the greatest lateral resistance should not exceed the average breadth of half the beam measured at the points of equal distance between the midship and either end; unless the centre of gravity by means of heavy ballast, as lead, be made to descend proportionally with any addition to the depth of the keel.

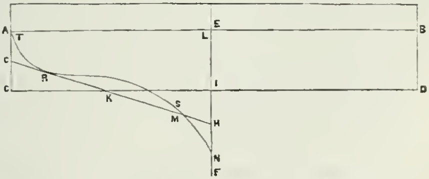
Again, as the above average depth is requisite for lateral resistance, then the midsip form, and likewise the sections towards both head and stern, must be moulded into those shapes which will meet the object desired, with the least increase of displacement beyond the true one the vessel ought to possess when required for speed, as in table 4, chapter XV.

Let the above be exemplified in the models O, Q, and R, and the diagram here annexed will assist in explaining the meaning.



No. 1. The Model O.—Scale ⅛-inch to 1 inch.

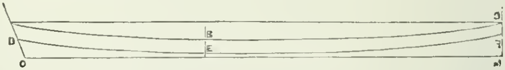
A C B D represents the half part of the horizontal section of the model O, taken at the low water-line; C D being the midship, and E F, G H, the lines of the average beam.



No. 2. Midship Section of Model O.—Scale, 1 inch to 1 inch.

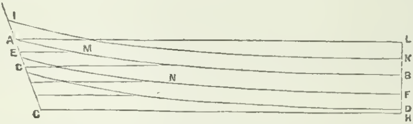
Let A B D C be the midship section of the model O, when with the flat bottom; L I the depth as stated in Table 4, Chapter XV. Now, in order to give speed to the model, the curved form must be applied to the bottom, which will cause the model to sink deeper into the water than before, by a one-fourth part of L I (see Chapter XVI.), or to the dotted line A E B.

Again, let E F equal the average breadth of beam, and F the bottom of the keel; but as every increase of the displacement beyond A B D C, will retard speed; yet the part of the dead wood and keel from I to F, require support; it can only be carried into practice by transferring a portion of the capacity, or displacement at and about C, to between I and F. To this end, let K bisect the straight line C I, and G bisect A C from G, and draw through K the straght line G K H. By Euclid, the triangles G C K, K I H, are equal, therefore their displacements are equal. But since the keel from H to F, will likewise need support, a curved brace may be applied from M to N, which will, however, cause some addition to the capacity; or the curve T M N, may be substituted. To obviate the evil of additional capacity in some measure, the space may be filled with ballast, which, being situated low, will assist to compensate, by increasing the stability, and in consequence admit of an addition being made to the sail sufficient for the wind to impel forward the extra weight with nearly undiminished speed. The angle at G may be rounded off or not, but as it is, the original stability will be diminished by the removing of the triangle G C K, to the triangle K I H, because it is sufficiently evident on inspection that the assumed centre of the triangle K I H, from the perpendicular line E F, is less than R, the centre of the triangle G C K; therefore the power of buoancy to aid stability is proportionally reduced, and which will not be altogether met by the ballast in the triangles K I H, and M H N; the stability will again be lessened also, if the angle at G is rounded off.



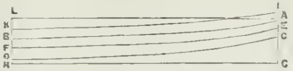
No. 3. Bottom Curves of Model O.—Scale, $\frac{1}{8}$-inch to 1 inch.

In this diagram (No. 3), A C is the load water-line, A B, B C, the bottom curves, and D E, E F, their union with the keel G H.



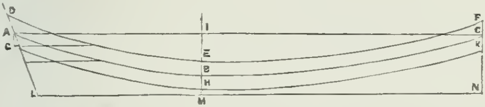
No. 4. Model O, from Head to Midship.—Scale, $\frac{1}{4}$-inch to 1 inch.

Here is represented the part of the model situated between the head and the midship. A L the load water-line, A B the curve as A B in No. 3, B being the depth of E I in No. 2, and I K the curve at the depth of A G in No. 2, and C D the curve uniting with the keel G H. The curves I K, A B, C D, and the dotted one E F, are all parallel to each other, and which must be carried out along the bottom of the ship in planes perpendicular to the horizon, and parallel to the ship's longitudinal axis. With regard to the lines E M, C N, &c., they must be drawn parallel to the load water-line to form a wedge of the bows, as repeated experiments, not entered, have determined this point over the bow curved alone; yet the outline of the said curve should be preserved wherever the lines touch, and made to take the concave form, with the express view of promoting speed, by assisting the raising of the bows over the waves, particularly of sailing vessels against the downward pressure of the wind on their canvass.



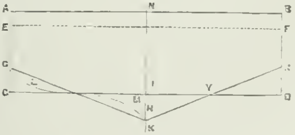
No. 4, *continued*.—Model O, from Midship Section to Stern.—Scale ⅓ inch to 1 inch.

Let L A be the load water-line, B A, F E, D C, the curves, and D C the one uniting with the dead wood and keel. In this part of a ship no lines parallel with the load water-line are necessary, indeed they would be hindrances to speed, as has been shown already in the experiments. But in order to strengthen the dead wood and keel, short braces placed at the angle of 45° may be employed where thought requisite, but the less the better.



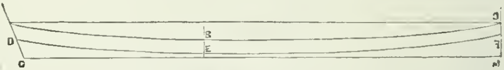
No. 5. Midship Section of Model Q.—Scale, ⅛ inch to 1 inch.

A I C is the load water-line, A B, B C, D E, E F, are the bottom curves, and G H, H K, the union with the keel L N; A R, G S, are parallel horizontal lines, as in No. 4, to form the wedge bow. The stern part, meaning from midship to stern, need not (as before stated) the horizontal parallel line, but the curved form preserved throughout. The concave of the horizontal lines, as mentioned in treating of the bows of the model O, cannot here be dispensed with.



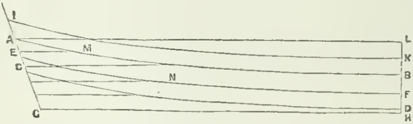
No. 6. Model Q.—Scale, ¼ inch to 1 inch.

Let A B D C be the midship section of the model Q, A B the load water-line, the depth being increased from E F to A B, as in diagram No. 2. N K the depth equal to the average breadth of half the beam of the model Q, taken as in the model O. It is seen in this instance, that the depth from I to K, is less than in No. 2; therefore the bottom may be preserved flat at the midship, with a straight or curved bracket, as it were, to support the keel, and continued fore and aft; or it may at once of the keel; but as every increase of the displacement beyond A B D C, will retard speed; yet the part of the dead wood and keel from I to F, require support; it can only be carried into practice by transferring a portion of the capacity, or displacement at and about C, to between I and F. To this end, let K bisect the straight line C I, and G bisect A C from G, and draw through K the straght line G K H. By Euclid, the triangles G C K, K I H, are equal, therefore their displacements are equal. But since the keel from H to F, will likewise need support, a curved brace may be applied from M to N, which will, however, cause some addition to the capacity; or the curve T M N, may be substituted. To obviate the evil of additional capacity in some measure, the space may be filled with ballast, which, being situated low, will assist to compensate, by increasing the stability, and in consequence admit of an addition being made to the sail sufficient for the wind to impel forward the extra weight with nearly undiminished speed. The angle at G may be rounded off or not, but as it is, the original stability will be diminished by the removing of the triangle G C K, to the triangle K I H, because it is sufficiently evident on inspection that the assumed centre of the triangle K I H, from the perpendicular line E F, is less than R, the centre of the triangle G C K; therefore the power of buoyancy to aid stability is proportionally reduced, and which will not be altogether met by the ballast in the triangles K I H, and M H N; the stability will again be lessened also, if the angle at G is rounded off.



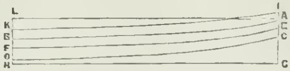
No. 3. Bottom Curves of Model O.—Scale, ⅛-inch to 1 inch.

In this diagram (No. 3), A C is the load water-line, A B, B C, the bottom curves, and D E, E F, their union with the keel G H.



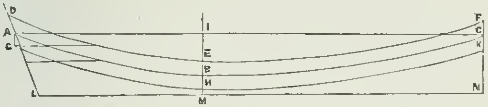
No. 4. Model O, from Head to Midship.—Scale, ¼-inch to 1 inch.

Here is represented the part of the model situated between the head and the midship. A L the load water-line, A B the curve as A B in No. 3, B being the depth of E I in No. 2, and I K the curve at the depth of A G in No. 2, and C D the curve uniting with the keel G H. The curves I K, A B, C D, and the dotted one E F, are all parallel to each other, and which must be carried out along the bottom of the ship in planes perpendicular to the horizon, and parallel to the ship's longitudinal axis. With regard to the lines E M, C N, &c., they must be drawn parallel to the load water-line to form a wedge of the bows, as repeated experiments, not entered, have determined this point over the bow curved alone; yet the outline of the said curve should be preserved wherever the lines touch, and made to take the concave form, with the express view of promoting speed, by assisting the raising of the bows over the waves, particularly of sailing vessels against the downward pressure of the wind on their canvass.



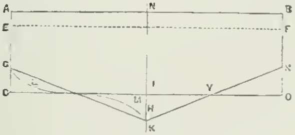
No. 4, *continued.*—Model O, from Midship Section to Stern.—Scale $\frac{1}{8}$ inch to 1 inch.

Let L A be the load water-line, B A, F E, D C, the curves, and D C the one uniting with the dead wood and keel. In this part of a ship no lines parallel with the load water-line are necessary, indeed they would be hindrances to speed, as has been shown already in the experiments. But in order to strengthen the dead wood and keel, short braces placed at the angle of 45° may be employed where thought requisite, but the less the better.



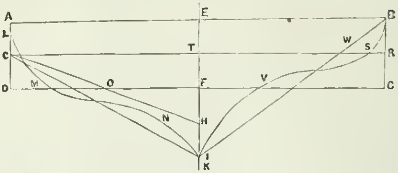
No. 5. Midship Section of Model Q.—Scale, $\frac{1}{8}$ inch to 1 inch.

A I C is the load water-line, A B, B C, D E, E F, are the bottom curves, and G H, H K, the union with the keel L N; A R, G S, are parallel horizontal lines, as in No. 4, to form the wedge bow. The stern part, meaning from midship to stern, need not (as before stated) the horizontal parallel line, but the curved form preserved throughout. The concave of the horizontal lines, as mentioned in treating of the bows of the model O, cannot here be dispensed with.



No. 6. Model Q.—Scale, $\frac{1}{4}$ inch to 1 inch.

Let A B D C be the midship section of the model Q, A B the load water-line, the depth being increased from E F to A B, as in diagram No. 2. N K the depth equal to the average breadth of half the beam of the model Q, taken as in the model O. It is seen in this instance, that the depth from I to K, is less than in No. 2; therefore the bottom may be preserved flat at the midship, with a straight or curved bracket,'as it were, to support the keel, and continued fore and aft; or it may at once take the form as shown in the diagram by the letters H Y X, X D being taken equal to I H, when the triangles H I Y, X D Y, will be equal. Instead, however, of either of these, the outline may be as the curve G L M H.



No. 7. Midship Section of the Model R.—Scale, ¼ inch to 1 inch.

A B the load water-line, E T the depth of flotation, as in Table 4, Chapter XV., with the addition of one-fourth part of the $\frac{13}{16}$ths, in consequence of the curved bottom, making the total or one inch; which, according to the scale above is half an inch, or B R; therefore, A B R G represents the true displacement. E K is the half part of the average beam (see diagram R, in Experiment 83), in which the straight lines A B, D F, denote them; but they being drawn on the scale of ⅛-inch to 1 inch, the average of the two, when doubled, will make it in the ¼-inch scale, as the diagram above, equal to E K, K being the bottom of the keel.

It appears upon the right-hand part of the diagram, that in order to support the necessary depth of keel, as T K, it must either have the timber of the bottom framed at midship, as in the dotted straight line I B, or in the curved one B S V K. If in the former, then the displacement will be doubled when completed on both sides of the model, and take proportionally from the speed, as recorded in Table 3, Chapter XV.; if the latter, still the original displacement will be increased, but not equal in degree to the former. The keel, however, cannot do without support; therefore, of the two evils, the latter must be preferred whenever speed is to be gained.

The form on the left-hand side of the diagram, comprehended and denoted by the curve L M N I, is graceful and effectual with regard to the keel; but then the displacement, even on inspection, exceeds more than double (it must be admitted) the true displacement required, and therefore will take too much from the speed, as evidenced in Table 3, Chapter XV., but would answer well if the vessel be intended for burthen instead of a yacht.

Further Observations.

In the models having their horizontal section at the load water-line, after the form of a bird or fish, as the sole, it is seen that the midship section or widest part, is situated at two-fifths of their length from the head, and three-fifths from the stern. This is Nature's law, in order to counteract and balance the extra resistance the forebody meets with against the air and water to what the aft body is subject. In Chapter III.

it is seen, when treating upon the law of lateral resistance, that when the model was drawn forward through the water, as well as sideways, the centre of lateral resistance, at the time, moved forward also; and the estimated proportion equalled one-twelfth the length of the model.

Let this result be compared with Nature's form. Take a model 28 inches long, its middle will then be 14 inches; divide 28 inches by 5, and the answer is 5½ inches. Now two-fifths of 28 equals 11; and three-fifths equals 16½; and 14 minus 11 equals 3, or 3 inches, which is the distance before the centre of length where Nature places her greatest width in birds, and in the sole fish. With the model in Chapter III. one-twelfth was the supposed place before the centre of length where the centre of lateral resistance resided when the body was moved both forward and sideways. The proportion of one-twelfth will be found to equal 2¼ inches, and rather more; being certainly less than 3 inches. It was stated, however, that increase of the speed of the model would cause the centre of lateral resistance to move still more forward. If granted, the average, allowing for mistakes, will be somewhere not far short of Nature's distance of 3 inches.

If the above statement be admitted near the truth, it follows, that whenever the line of greatest breadth of beam in a ship be situated aft the two-fifths of length, so as to destroy the balance of three-fifths of stern length, the evil must be compensated for, giving an equivalent in extra depth of keel towards and at the stern. Hence, the further aft the midship section be placed, the deeper must the keel be made, to preserve the due proportions of perpendicular surface of the two-fifths and three-fifths between the body before the midship and the body aft of the midship. Now, great depth of keel towards and at the stern is a serious evil in all ships destined for shallow waters, and is objectionable, in another point of view, as in respect of lee-way, on account of the greater power, from increased leverage, to overturn.

The forms of ships as regards beam to length, especially those for merchandise, should be regulated in a measure by the nature of the climate and sea in which they are destined to navigate. For, if to encounter stormy winds and seas, whose average continuance is above that in other climates and seas, their breadth of beam and angle projections ought to be strongly kept in view, and acted upon by the builders, to assist the stability. If, on the other hand, the winds and seas are comparatively moderate, less beam will be requisite, or greater length of vessel, and all angles dispensed with. Moreover, ships requiring much sail, in consequence of the breadth of beam, will need hands in proportion, to manage the same; which circumstance, being an item of increased expenditure, will ever have its weight with the owners of merchantmen. This does not apply, however, to men-of-war, whose hands are generally in sufficient number for all duties.

With the completion of these few hints, which have been derived from careful experiments, observations, and reflections, although upon a small scale, I now take my leave, sincerely hoping they will induce persons of far more competent abilities than I possess, to engage in making investigations upon a large scale, that the true principles of shipbuilding may no longer continue a mystery.

high temperature, under constant pressure in air-tight metallic vessels, strong enough to resist an internal pressure sufficient to act upon the molecules of the indigo to incorporate them with the fibres of the stuff, and thus produce a change in the physical constitution of the indigo.

The form of the vessels employed is immaterial, but they must be furnished with a safety-valve, and also with a cock, through which the atmospheric air may escape on the introduction of the steam.

The stuffs dyed with indigo are laid one upon another in the vessel in question upon a wooden pan, and enclosed in a cloth, which serves to prevent their coming in contact with the sides of the vessel, and also to absorb the moisture which is produced at the first introduction of the steam. The steam is then allowed to flow in at a pressure of from 2 to 6 atmospheres. After the lapse of about twenty minutes or half an hour, the cover of the apparatus is removed, and the stuffs taken out and left to cool, when they may be folded and packed.

This operation communicates a violet tinge to the color of the indigo, without in the least injuring the other true colors fixed on the stuff, which, on the contrary, become fuller and brighter. The web loses considerably in length in the operation, but the loss of breadth is scarcely perceptible; at the same time a thicker and finer texture and more body and softness are obtained.—*Schweig. Gewerbeblatt*, xi. p. 98.

For the Journal of the Franklin Institute.

The Reading Steam Forge.

We are pleased to record the opening of this establishment, which is creditable to the enterprise of our neighbors in Reading, and will doubtless be found highly advantageous to manufacturers in this and other cities. No locality can be found combining greater facilities for cheap execution of iron forgings, than the one selected for the works in question. It is in the midst of one of the richest iron districts of this State; and being on the line of the Philadelphia, Reading, and Pottsville Rail road, the great avenue for the coal trade of Pennsylvania, coal can be procured at a very low rate, while every facility is offered for the transportation of finished work to this city at all seasons of the year.

The main building is 260 feet, by 100 wide, and contains at present, three of Kirk's patent steam hammers (the heaviest weighing 26 cwt.,) intended for small work. For the heavier class of forgings, a Nasmyth steam hammer is now building, which is to have a five ton ram falling seven feet—one of the largest in the country. The company is also erecting a furnace and machine for the manufacture of locomotive wheel tires, a heavy shears and slotting machine, and a large lathe, (vertical,) suitable for boring heavy cranks, &c. At some future time it is intended, we believe, to put up a puddling furnace and rolls, so that all the processes of manufacture from the pig, will be carried on under the same supervision. The steam required for the engine and hammers is made entirely by the waste heat from the furnaces, over which the boilers are set. Coal brought direct from the mines, is deposited at the door by a branch from the Reading road; and two other branch tracks traverse the building, so that a locomotive enters and is attached to the cars on which finished work has been deposited by the cranes. The economy resulting from these arrangements is obvious. The establishment is fully worthy a visit, as it combines the improvements made up to the present time in each department.

The New Patent Law of Great Britain. By John Henry Johnson, Solicitor and Patent Agent.*

This act having already made its appearance in full, in many of our contemporaries, we think our readers will derive more benefit from a general statement of the changes which it effects, and the machinery through which it acts, than from a mere copy of the act itself. This is the more obvious to us, as the act is by no means particularly clear to the comprehension even of those most accustomed to the construction of the statutes; and it would be still more unintelligible to the majority of our readers, who do not probably number amongst them many members of the legal profession. Hence, the following translation may perhaps be found worthy of acceptation :

Commissioners.—The Lord Chancellor, the Master of the Rolls, the Attorney and Solicitor Generals for England and Ireland, the Lord Advocate and Solicitor General for Scotland, and such other persons as her Majesty shall appoint, are to be "Commissioners of Patents for Invention;" any three of whom (the Lord Chancellor or Master of the Rolls being one) may act.

The commissioners are to have a seal of office, and are to make rules of practice, to report annually to parliament, and to appoint such clerks and officers as they may think proper.

Provisional Protection.—A petition, declaration, and provisional specification, very similar to the documents at present required on petitioning for letters patent, are to be left in the commissioners' office, and to be referred by them to one of the law-officers, who will have the power to call scientific assistance to his aid. If the law-officer approves of the title and provisional specification, both of which he can allow or require to be amended, he is to give a certificate of such approval or allowance, which is to be filed in the commissioners' office, whereupon the invention may, for six months from the date of the petition, be used and published without prejudice to any letters patent to be granted for the same. The entire expense of this proceeding, including agency, fees, &c., will probably amount to £10 10s. As the validity of the patent will principally depend upon this provisional specification, it will be necessary to frame it with the greatest care and consideration.

Instead of the proceeding last described, the applicant for letters patent may file, with his petition and declaration, in the commissioners' office, a complete specification of his invention ; whereupon a certificate of the filing having been given him, the invention is protected for a period of six months, as before. Any letters patent granted, therefore, are to contain a clause, conditioning them to be void if this specification does not fully describe the invention; a copy of the specification is to be open for public inspection from the time of its deposit. The commissioners are to cause these "protections" to be advertised as they may see fit. The expense of this protection will of course vary in every case, with the nature of the invention, and the amount of trouble or skill required in preparing the specification and drawings, if drawings are necessary: the actual payment to government will be £10.

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* From the London Practical Mechanic's Journal, August, 1852.

Completion of the Patent.—When the applicant is desirous to complete his patent, after either of the preliminary steps before described, he is to give the commissioners notice to that effect; the application is then to be advertised, and parties desirous of opposing the grant are, within such time as the commissioners shall appoint, to leave with the commissioners notice in writing of their grounds of opposition. When the time for this purpose has expired, the applicant's provisional or complete specification, and the particulars of objection, are to be referred to the law-officer to whom the application has been referred; the law-officer is to decide upon the matter as he may think fit, and, if he deems it advisable, he has the power to decide by whom the costs of the application, reference, and hearing (if any) shall be paid. After the law-officer's decision, he is to issue his warrant for the sealing of the patent; the warrant is to be sealed with the commissioners' seal, and is to set out the clauses and restrictions to be contained in the grant. The same power is reserved to the Lord Chancellor as to the making and issuing of patents under this warrant, as he possesses under the present system; and power is also reserved to her Majesty, by warrant under her royal sign manual, to direct the law-officer to withhold his warrant, or to direct that no letters patent shall issue under his warrant, or to direct the insertion in the letters patent of any provisions or restrictions she may think fit, and also to direct any complete specification which may have been filed, to be cancelled, upon which the protection obtained shall cease.

The letters patent are to be void unless £50 be paid at the end of three years from the date thereof, and £100 further at the end of seven years. Certificates of these payments are to be issued under the commissioners' seal, and receipts therefor to be endorsed on the letters patent; such certificates to be legal evidence of the payments.

After the sealing of the warrant, and when required by the applicant, which must be within three months from the date of the warrant, the commissioners are to cause letters patent to be prepared, and the Lord Chancellor is to affix the great seal thereto; such letters patent extending to the United Kingdom of Great Britain and Ireland, the Channel Islands, the Isle of Man, and such of the Colonies as have been specially petitioned for, and are named in the warrant. These letters patent are to be of the same effect as the three distinct grants now are. One transcript of the letters patent is to be entered in the Records of Chancery in Scotland, in the same manner, and to the same effect, as letters patent for Scotland now are; and copies of, or extracts from, such transcripts are to be received as evidence in the Scotch law-courts, with the same effect as the letters patent themselves. Another transcript is to be transmitted for enrolment in the Chancery Enrolment Office in Dublin, and is o have the same effect in Ireland as letters patent for that country solely now have. Letters patent are not to issue, unless granted during the period of preliminary protection already fully described, except in case application has been made to seal the letters patent, and such sealing has been delayed by reason of a caveat or application to the Lord Chancellor against their being sealed, or in case of the death of the petitioner during the continuance of the preliminary protection, under which circumstances the executors or administrators of the applicant may obtain the seal within three months after his decease.

Letters patent may be sealed as of the day of the date of the application, or in case of any invention protected under the "Protection of Inventions Act, 1851," the act passed for the protection of inventions exhibited at the 1851 Exhibition—as of the day of the provisional registration, or of the day of the sealing of the letters patent, or, in the discretion of the Lord Chancellor and the law-officer, of any other day between the day of application or provisional registration, and of sealing: but, *except in case a complete specification has been filed with the application*, no legal proceedings can be adopted for infringements committed before the patent was actually sealed. This is a very important provision, and for this cause t may be desirable, in some cases, to file a complete specification with the application.

Specifications.—Specifications are to be filed instead of being enrolled, and all provisional and complete specifications filed in the commissioners' office shall, immediately on the completion of the letters patent, and where no patent is issued, then within six months from the date of the application, be transferred to the office in Chancery, where specifications are to be filed. If drawings are alluded to in the specification, two copies of such drawings are to be left with the specification.

Copies of all specifications, disclaimers, memoranda of alterations and provisional specifications, after the expiry of the term of their provisional protection, are to be open for inspection at the office of the commissioners, and at offices in Edinburgh and Dublin.

Specifications, disclaimers, and memoranda of alterations, are to be printed and published, and sold as soon as conveniently may be after their being filed; and the commissioners may present copies thereof to such public libraries and museums as they may think proper, and the patentee may have twenty-five copies of such publications without any charge; and these copies, printed by the Queen's printer, are to be *prima facie* evidence of the existence of the originals in all law-courts. The proceedings now in operation, under the Acts 5 and 6 Wm. IV., c. 83, and 7 and 8 Vict., c. 69, as to disclaimers, memoranda of alterations and confirmations, are to be applicable to letters patent obtained under his act.

Registers.—The office in Chancery, where specifications are to be filed, s to keep a "Register of Patents," wherein will be recorded, in chronological order, all letters patent granted under this act, the deposit or filing of specifications, disclaimers, and memoranda of alterations, all mendments, all confirmations and extensions, the expiry, vacating or cancelling letters patent, with their dates, and all other matters affecting he validity of patents, as the commissioners may direct.

The same office is to keep a "Register of Proprietors," wherein is to be entered, as the commissioners shall direct, the assignment of any patent, or of any interest therein, any license, and the district to which it refers, with the name of any person having any interest in such patent or license, and the date of his acquiring the same, and any other matter relating to the proprietorship; and copies of such entries, certified under the seal of the office, shall be received as *prima facie* evidence of such transactions. Until such entries have been made, the original patentee is to be deemed the sole party interested. Duplicates of the entries in the "Register of Proprietors" are to be open for inspection in Edinburgh and Dublin.

Any person obtaining a false entry in the register of proprietors, is deemed guilty of a misdemeanor, and will be punished accordingly; and any person deeming himself aggrieved by any entry therein, may apply, by motion, to the Master of the Rolls, or to any of the courts of common law at Westminster, in term, or to a judge in vacation, for an order to expunge, vacate, or vary such entry, which may be ordered. We consider these provisions to be of great importance, as at present there is no method by which information as to dealings with patents can be obtained.

Patents for Foreigners.—Where an application is made under this act for the United Kingdom, in respect of any invention *first invented in any foreign country*, or by the subject of any foreign power or state, and a monopoly therefor has been obtained in any foreign country before the date of letters patent for the United Kingdom, the British patent is to become void immediately upon the determination of the foreign patent, or where several foreign patents have been obtained, upon the expiration of the first of such foreign patents; and no patent granted for an invention for which a patent has been obtained abroad, and has expired, is to be valid in the United Kingdom. This clause will render it very desirable for foreigners, or Englishmen resident abroad, to obtain their British patent before doing anything in the country where they are resident. We are afraid the alteration in this respect, which appears to be quite uncalled for, will be a source of great trouble to foreign patentees. No British patent is to extend to foreign ships within British ports, except in the case of ships belonging to foreign countries whose laws will prevent the use of their subjects' inventions by British ships whilst in the ports of such foreign countries.

As to Patents applied for before Passing of Act.—Patents may be granted on applications made before the passing of the act, as if the act had not passed; and where letters patent for England, or Scotland, or Ireland, have been granted before the passing of the act, or are in respect of any application made before the passing of the act, hereafter granted for any invention, letters patent for England, or Scotland, or Ireland, may be granted for such invention as if the act had not passed, except that, in place of the existing fees, there shall be paid for each country a sum equal to one-third of the total fees to be paid for the United Kingdom under this act.

Fees and Stamp Duties.—The under-mentioned fees and stamp duties are to be paid. The stamp duties are to be under the control of the

Commissioners of Inland Revenue, and the provisions of the present Stamp Acts are to be applicable thereto. The fees to be paid into the receipt of the Exchequer, and are to form part of the Consolidated Fund. The law-officers' fees, in cases of appeals, oppositions, disclaimers, and memoranda of alterations, are to be paid as heretofore, and the Lord Chancellor and the Master of the Rolls are to determine the fees to be paid the law-officers, and also the charges for office copies, certificates, &c., to be granted under this act.

Persons now holding offices abolished by this act are to be compensated.

Fees.	£	*s.*	*d.*
On leaving petition for grant of letters patent.	5	0	0
On notice of intention to proceed with the application,	5	0	0
On sealing of letters patent,	5	0	0
On filing specification,	5	0	0
At or before the expiration of the third year,	40	0	0
At or before the expiration of the seventh year,	80	0	0
On leaving notice of objections,	2	0	0
Every search and inspection,	0	1	0
Entry of assignment or license,	0	5	0
Certificate of assignment or license,	0	5	0
Filing application for disclaimer,	5	0	0
Caveat against disclaimer,	0	2	0
Stamp Duties.			
On warrant of law-officer for letters patent,	5	0	0
On certificate of payment of the fee payable at or before the expiration of the third year,	10	0	0
On certificate of payment of the fee payable at or before the expiration of the seventh year,	20	0	0

There are some clauses relative to legal proceedings upon letters patent, of which no abstract is given, as it is thought they would not be very intelligible to inventors and intending patentees, for whose information only we have prepared this abstract.

Summary of Chief Alterations.—In place of a separate, most expensive, and tedious process for each kingdom, one grant of letters patent will extend to the whole of the United Kingdom; and one specification only of the invention will have to be filed.

A preliminary protection will be given for a period of six months, at a slight cost, within which period an inventor will have the opportunity of publishing and of testing the actual merits of his invention.

Letters patent will be granted on a scale of fees payable at three periods—on obtaining the grant, at the expiration of three years, and at the expiration of seven years, instead of the total amount having to be paid on the commencement, as at present.

The practice is thus assimilated to that of the principal continental states, as the costs of obtaining protection are, as it were, proportioned to the success of the invention. For, if successful, or promising to be so, at the end of three years, the patentee will gladly pay the additional sum required; whereas, if unsuccessful, he very naturally will not.

On the Occurrence of Metallic Iron in Fossil Wood. By W. G. Lettsom, Esq.*

In the recent edition of Phillip's Mineralogy by Messrs. Brooke and Miller, at page 685, mention is made of the discovery of metallic iron in certain metamorphic rocks in Antrim by Dr. Andrews, of Belfast; and as this fact is a novel one, perhaps the following account of the occurrence of this substance in a metallic state in Sweden, translated from a periodical which appears here under the title of *El Restaurador Farmeceutico*, may be thought worthy of a place in the pages of the Philosophical Magazine.

M. Bahr, a pupil of Prof. Svanberg, has had occasion to analyze the fossil wood derived from an island in the lake of Ralang in Smaland, whose composition resembled that of the mineral known by the name of limonite.

On endeavoring to pulverize this mineral in small quantities, he observed some minute tenacious grains which yielded but very little to the action of the agate pestle. These grains were simply metallic iron; they became flattened by the blow of a hammer, were attracted by a magnet, and were soluble in acid with evolution of hydrogen.

M. Bahr enters upon the question, whether this iron had been formed in the mass of this wood by the reduction of some soluble salt of iron, or whether it has been originally introduced in the form of a nail, or the fragment of some tool or instrument, which, after having been partially destroyed by oxidation, may nevertheless have left some traces of its presence in the metallic state.

After having examined and discussed with care the origin, characters, structure, and composition of the specimen of fossil wood in question, M. Bahr arrives at the conclusion that the iron has been really deposited in the metallic state, and that the singular mineral submitted to his examination presents the first well-established instance of the occurrence of terrestrial native iron.

Among the points on which M. Bahr bases his opinion, may be cited the following:—

The specimen of fossil wood in question was detached on the 28th of August, 1798, from the thick end of the trunk of a tree that was met with on the floating island in the lake of Ralang in Smaland. This island, after being submerged for four years, had risen to the surface the evening before. At the end of the trunk there were two plates of copper, bearing an inscription commemorative of the date when Gustavus III. visited this singular island, which appears in its origin to have formed a tongue of land boarded over, which became detached from the mainland by the action of the waters of the lake. It is usually submerged, but from time to time it rises to the surface for a few days, most commonly in the months of August and September.

M. Bahr had submitted to him two specimens of this fossil wood, which in its external appearance very much resembled a fragment of limonite. The specific gravity of one of these fragments was 3·85, of the other only

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* From the Lond., Edinb., and Dublin Philosoph. Magazine, November, 1852.

2·94. When the surface was brushed with the feathery part of a quill, metallic iron was rendered visible, penetrating the general mass of the wood in a pulverulent form, or in the state of scales and angular and rounded grains. This structure was more clearly seen by means of a magnifying glass or of a microscope, which showed the fibres of the wood separated by the pulverulent iron. Here and there these grains of iron were of an appreciable magnitude, and were joined together like beads in a rosary. A group of five such grains was about a millimetre in length. In other portions of the specimen they might be detached, leaving cavities resembling the organic cellules. The specific gravity of this iron (in consequence, probably, of its admixture with organic matters) is very inconsiderable. In two trials it was found to be 6·248 and 6·4972; in a third and last experiment instituted with a grain of iron flattened by the blow of a hammer, it was found to be 6·6255.

M. Bahr analyzed these grains of iron, having first freed them as much as possible from all organic substances, and the results that he obtained are stated below. The solution was effected by means of very dilute nitric acid, and the portion thus dissolved amounted to 80·16 per cent. of the total weight of the grains, and contained the following substances calculated in the form of oxides:—

Silica	0·818
Phosphoric acid	0·500
Nickel (and cobalt)	0·129
Lime and magnesia	0·178
Alumina	0·213
Vanadic acid	trace
Manganese	trace
Protoxide of iron (by difference)	98·171
	100·009

The residue, insoluble in very dilute nitric acid, contained also portions which obeyed the action of the magnet; and these in like manner were subjected to analysis, and gave the following results calculated in the state of oxides:—

Silica	0·619
Phosporic acid	3·159
Vanadic acid	1·402
Oxide of nickel (with oxide of cobalt)	0.737
Oxide of iron	94·464
Manganese	trace
	100.381

So far M. Bahr, the original source of whose paper I am unable to state, as it is not given in the Spanish version of it. In conclusion I may observe, that I possess in my collection of minerals a specimen of limonite from Passau in Bavaria, containing small threads and veins of iron in the metallic state.

Madrid, Sept. 23, 1852.

On the Production of Photographs on Glass. By J. Pucher.*

According to this process, a thin film of iodide of sulphur is formed upon plate glass, by covering the glass, which must be perfectly clean, with a very thin coating of sulphur, and then impregnating this for a few seconds with the vapor of iodine. The glass plate is then placed in the camera, where at the same time the vapor of some quicksilver in an iron cup in the bottom of the camera acts upon the iodide of sulphur with which it is coated, and it receives the photographic image within a minute. The glass plate, when taken out of the camera, only exhibits a trace of the picture, but this immediately comes out on exposure to the action of the vapor of bromine. If the picture be now held over alcohol, and some of the same liquid be poured upon it, it will be fixed. Not more than from five to eight minutes are required for the whole operation.

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* From the London Chemical Gazette, August, 1852.

The glass plates must be breathed upon and well rubbed with soft linen rag several times before use. They are coated with sulphur by burning sulphur sticks, made on purpose, in a proper tube, and holding the plates over it at a distance of about 3 inches. These sulphur sticks are prepared by dipping pieces of rush-pith into a melted mixture of sulphur and mastic, with which they become incrusted. For use, these sulphur sticks, which are about the size of a lucifer match, are stuck on a brass needle, introduced into the middle of a glass tube and kindled, so that the vapor of the sulphur may come in contact with the glass plate held over it.

These glass plates are so sensitive, that the coating of iodide of sulphur becomes instantly changed on exposure to direct sunlight, and give a Moser's image within five minutes when laid in a book. The figures thus obtained are most easily read by candlelight. In daylight, the blue letters can be recognised on the yellow ground only by looking through the plate towards the middle of the window, or towards a sheet of paper fastened in that place, the sulphur not having been removed either by vapor of bromine or by alcohol.

If a glass plate, covered with a solution of gum and exposed to the vapor of iodized sulphur, be placed in the camera, a positive picture, with all its details, is obtained, the outlines of which can be laid bare by an etching-point capable of scratching the glass. If a glass plate, so marked, be rubbed in with printing ink, the outlines will be filled, and the ink will remain in them when the glass is freed from the coating of gum by means of water. The picture is then easily transferred to paper, which is to be laid on the plate and rubbed over with a paper-knife.—*Archiv der Pharm.*, lxix. p. 301.

Extracts from Lectures on the Results of the Great Exhibition of 1851, *delivered before the Society of Arts, Manufactures, and Commerce, at the suggestion of His Royal Highness Prince Albert, President of the Society.**

I.—Sir Henry De la Beche.

1. *Amount of British Iron.*—The Exhibition may be said to have given rise to the most complete view of the iron produce of this country

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* From the Edinburgh New Philosophical Journal, 1852.

which we possess. Mr. Samuel Blackwell, himself an ironmaster, accompanied the collection of iron ores by a statement of great value. He estimates the gross annual production of iron in Great Britain to be now upwards of 2,500,000 tons. Of this quantity, South Wales furnishes 700,000 tons; South Staffordshire, (including Worcestershire), 600,000 tons; and Scotland 600,000 tons. The remainder is divided among the various smaller districts. The iron of England and Wales was produced by 336 furnaces in blast in 1850. Though a considerable quantity of British iron is exported, a very large proportion remains to be variously employed in our own industry.

2. *Desilverizing of Lead.*—As to lead, the illustrations were chiefly British. There was an excellent exhibition of Pattinson's important process for desilverizing that metal—a process which has been of such service to lead-mining generally, rendering many lead-mines workable with profit which must otherwise have been abandoned. The chief ore whence lead is extracted is that known as galena, or the sulphuret of lead, furnishing from seventy-five to eighty-three parts of the metal, according to purity. It usually, though not always, contains silver in variable proportions. Upon the quantity of silver often depends the profitable raising of the ore. Previous to the invention of Mr. Pattinson, (of Newcastle-upon-Tyne,) about twenty ounces of silver in the ton of lead were required to render the extraction of that metal worth the cost; since then as little as three and four ounces in the ton of lead will repay extraction. Now, as so many ores contain small quantities only of silver, the importance of the process is evident. In a scientific point of view, it is one of much interest, as it consists in so conducting the work that portions of the lead can crystallize, by which the silver becomes excluded, in the manner in which, in many crystallizing processes, foreign substances are excluded during crystallization. Thus, by degrees, a mass of mixed lead and silver is left, extremely rich in the latter. When this richness in silver arrives at the point desired, that metal is extracted in the usual manner by cupellation. The lead-smelting at the Allenhead's mines, and at the Wanlockhead Hills, Dumfrieshire, both excellently displayed, are both founded on Pattinson's process. While touching on the Wanlockhead Hills exhibition, we should not pass over the arrangements by which the fumes from the furnace are prevented from escape, and from damage to the surrounding country, while lead, to the amount of thirty-three per cent. from the deposits or "fume," is obtained.

III.—Dr. Lyon Playfair.

1. *Iron Smelting.*—Let us select the smelting of Iron,* as an example of the teachings of chemistry. If practice, unaided by science, be sufficient for the prosecution of manufactures, this venerable art must be thoroughly matured, and science could scarcely expect to be of much use to it in its present state. But while we find much to admire in the triumphs of practical experience, there is yet great room for the improvement of this art. The cheapness of iron ore, and of the coal used in its smelting,

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* Although the smelting of iron is not strictly within the division of Manufactures, according to the classification, its importance to this country will authorize an exception in its favor.

has been so great that, regardless of their capital importance to this country, we, like careless spendthrifts, use them without thought of the future.

The mode of smelting iron consists in mixing the ore with lime and coal; the former producing a slag or glass with the impurities of the ore, while the coal reduces the oxide of iron to its metallic state. Much heat is required in the process of smelting, but the cold air blown in, as the blast, lowers the temperature, and compels the addition of fuel, as a compensation for this reduction. Science pointed to this loss, and now the air is heated before being introduced to the furnace. The quantity of coal is wonderfully economized by this application of science; for instead of seven tons of coal per ton of iron, three tons now suffice, and the amount produced in the same time is nearly sixty per cent. Assuredly this was a great step in advance. Could science do more?

Professor Bunsen, in an inquiry in which I was glad to afford him aid, has shown that she can. We examined the furnaces, in each portion of the burning mass, so as fully to expose the operations in every part of the blazing structure. This seemingly impossible dissection was accomplished by the simplest means; the furnaces are charged from the top, and the materials gradually descend to the bottom; with the upper charge a long graduated tube was allowed to descend, and the gases streaming from ascertained depths were collected and analyzed. Their composition betrayed with perfect accuracy the nature of the actions at each portion of the furnace, and the astonishing fact was elicited, that, in spite of the saving produced by the introduction of the hot blast, no less than 81½ per cent. of fuel is actually lost, only 18½ per cent. being realized. If, in round numbers, we suppose that four-fifths of the fuel be thus wasted, no less than 5,400,000 tons are every year thrown uselessly into the atmosphere; this being nearly one-seventh of the whole coal annually raised in the United Kingdom. This enormous amount of fuel escapes in the form of combustible gases, capable of being collected and economized; yet in spite of these well-ascertained facts, there are scarcely half-a-dozen furnaces in the United Kingdom where this economy is realized by the utilization of the waste gases of the furnace.

Large quantities of ammonia are annually lost in iron smelting, which might readily be collected. Ammonia is constantly increasing in value, and each furnace produces and wastes at least 1 cwt. of its principal salt daily, equivalent to a considerable money loss. With the low price of iron, this subsidiary product is worthy of attention. As I write, a Welsh smelter has visited me, to say that he has adopted this suggestion with advantageous results. I might adduce other improvements introduced by chemistry in the smelting process; but these will suffice to show you that she has added to human power by increasing production, while she has also economized both the time and the materials employed.

On a new Yellow Dyeing Agent for Silk and Woolen, discovered by M. Guinon, of Lyons. By ROBERT WARINGTON.*

In the early part of last year, (March 2, 1851,) a specimen of a material for dyeing silk of a fine clear yellow color, without the aid of a mordant, was put into my hands for examination. It had been obtained in France, and was for the time supposed to be kept a secret. It was of the consistence of a soft extract, dissolved almost entirely in hot water, with the exception of a small quantity of brown resinous matter; and on the addition of a little tartaric acid, produced a fine clear yellow on silk by its being immersed in it for a short time; if a mordant be used, the color is much faster. This substance proved, on chemical examination, to be the picric, nitropicric or carbazotic acid in an impure state.

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* From the London Chemical Gazette, July 15th, 1852.

As the parties for whom the investigation was undertaken, wished to be informed as to a process for its manufacture, I made a series of experiments on this subject, and found that the action of nitric acid upon the resins of *Xanthorrhœa hastilis and X. arborea* afford an excellent product for this purpose. These gums are known in commerce, the first as gum-flavum, or yellow gum, and gum-acaroides, and that from the latter as black-boy gum, or grass-tree gum. The former was suggested some years since* by Dr. Stenhouse, as likely to prove the best source of carbazotic acid. As thus prepared, a very pure, dry, crystalline carbazotic acid is readily obtained, and at a very cheap rate, the resin yielding about half its weight of crude acid.

In October of last year, I made application, through Dr. Playfair, to the Industrial Exhibition, to endeavor to obtain a small specimen of these gums, as exhibited in the Australian department, for the purpose of identification, and to ascertain their value, but unfortunately without success, having received a polite note from the Executive Committee, stating that my application would be taken into consideration when all public institutions had been supplied. Failing in this direction, I have since been able to ascertain that it can at present be obtained in the drug market in small quantities at from 36*s*. to 40*s*. the cwt.; and I have also learnt, that if there were a sufficient demand, it could be imported at from 14*s*. to 20*s*. the cwt., making the cost of carbazotic acid about 6*d*. the pound.

I may state that I also communicated this investigation and process to Professor Magnus, of Berlin, during his sojourn in London in September, 1851, and have since forwarded him a small parcel of the resin.

The process employed in France has since been published by M. J. Girardin, of Rouen,† and consists in treating coal-tar with nitric acid. The price of the impure acid, as examined, is 25 francs the kilogramme, or about 9*s*. 6*d*. the pound avoirdupois.

Method of Crystallization by means of an uninterrupted Circulation. By M. PAYEN.‡

To procure substances in larger and more regular crystals than is possible by the ordinary processes, the author has made use of a very simple apparatus, in which a constant current is produced by a slight difference of temperature. An alembic is furnished at the top with a head, and both are filled with the substance to be dissolved. From the head a tube enters the top of a vessel standing beside it. A second tube goes from the base of this vessel into the alembic. All these vessels, alembic, head and supplementary vessel, together with the tubes, are filled with the solvent, and by heating the alembic on the water-bath by means of a spirit-lamp, a constant current is produced, in consequence of which, crystals, which gradually increase in size, are formed in the supplementary vessel. By treating sulphur and benzine in this manner, the author obtained octahedral crystals of sulphur of much larger size than by any other method.—*Comptes Rendus*, xxxiv. p. 578.

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* Memoirs and Proceedings of the Chemical Society, vol. iii. p. 10.

† Journal de Pharmacie et de Chemie, vol. xx., Jan. 1852.

‡ From the London Chemical Gazette, July 15th, 1852.

Analysis of a new Alloy for the Plates for Calico Printers. By CONRAD FISCHER.*

A white alloy, which is peculiarly adapted for the plates used in calico printing, and is used for that purpose in Ghent, has the following composition:—

Tin	46·81
Lead	37·44
Bismuth	15.75

Journ. für Prakt. Chem., lv. p. 192.

Electro-Metallurgy applied to Ornamentation of Glass, China, &c.†

Mr. John Ridgway, of Cauldon-place, Staffordshire, china manufacturer, has recently patented certain improvements in the method or process of ornamenting or decorating articles of glass, china, earthenware, or other ceramic manufactures. In the specification of his patent, just enrolled, Mr. Ridgway states that his first object is to apply a new glaze, which shall enable the metallic coating to adhere firmly, by capillary attraction, and give affinity for copper as a first coating. In pursuance of this, he first submits the article to an alcoholic solution, or a gelatinous solution. He then brushes over it an impalpable powder, composed of half carburet of iron, and half sulphate of copper. The article thus treated is then to be corroded by the fumes of hydro-fluoric acid. The article is then to be smoothed, by brushing it over with silver sand, or by the scratch-brush; but when the shape and nature of the article will not admit of this, it is to be plunged into a liquor, consisting of 6 quarts sulphuric acid, 4 quarts aquafortis, ¾ oz. muriatic acid, and 6 quarts water. Grease is to be carefully removed from the article, and a thin film of mercury is to be applied. The solution of copper consists of 1 sulphate of copper, and 4 filtered water. Suitable solutions for silvering or gilding are to be applied, in accordance with the practice of electrotyping. The claim is not to the solutions for coating as such, but to the application of "electrotyping," or electro-metallurgy, to the objects stated in the title, provided the articles be so prepared as to allow them to combine from an alloy with them.

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* From the London Chemical Gazette, July 15th, 1852.

† From the London Railway and Commercial Gazette, No. 896.

Improvement in the Production of the "Bleu de France" on Wool.[*]

The method at present in use for the production of "bleu de France" on wool, consists in boiling the wool in a bath containing ferridcyanide of potassium, an acid and chloride of tin, until the pure blue color is produced. In the course of this operation, much cyanogen escapes in the form of hydrocyanic acid. The loss of this substance, which is of so much importance in the formation of the blue color, led to the idea of altering the process as far as possible in such a manner as to retain the whole or greater part of the cyanogen in the bath, and precipitate it in combination with iron upon the fibres of the wool. Experiments undertaken with this view showed that this end can be attained by adding to the bath a salt of oxide of iron: the best is perchloride of iron. The dyeing takes place in the following manner :—The ferridcyanide of potassium is first dissolved in the bath; a small portion of the acid to be used is then added, and afterwards the chloride of tin and chloride of iron. The bath is now clear, and of a brownish color. The wool, well-washed and lukewarm, is then put in, and the whole heated to boiling. The wool immediately acquires a dark green color, and by boiling, after the addition of the remainder of the acid, becomes of a fine blue color.

The experiments made with this dyeing process gave favorable results in every instance. By its use a certain tone of color was produced with 25 per cent. less ferridcyanide of potassium than by the usual process.

Experiments made to determine the best proportion in which to add the chloride of iron, showed that an addition of chloride of iron (solution of iron in muriatic acid, into which chlorine was afterwards introduced, or which, after the addition of half as much more muriatic acid as was first employed, was treated with nitric acid), equal in weight to half or three-fourths of the ferridcyanide of potassium employed, produced the greatest effect, whilst a larger quantity gave a paler color. It is necessary to be cautious in adding the acid in this process, as less acid is sufficient here than in the usual method; tartaric acid gave the most favorable results. The ferridcyanide of potassium employed must of course contain no ferrocyanide, because, in this case, on the addition of the perchloride of iron, a precipitate of prussian blue would be formed. The compounds occurring in commerce can therefore be used only if they are quite free from admixture of this salt.—*Deutsche Musterzeit.*, 1851, No. 3; *Schweiz. Gewerbeblatt*, xi. p. 119.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 16, 1852.

John E. Addicks, President, pro. tem., in the chair.

George M. Conarroe, Recording Secretary, pro. tem.

The minutes of the last meeting were read and approved.

Donations were received from the Royal Cornwall Polytechnic Society, Falmouth; The Royal Astronomical Society, London; Hon. Joseph R.

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[*] From the London Chemical Gazette, November 15th, 1852.

Chandler, U. S. Congress; John Wiley, Esq., New York; and from the Philadelphia, Germantown, and Norristown Railroad Company, and Messrs. E. D. Ingraham, Dr. John Redman Coxe, Frederick Graff, John W. Nystrom, and Geo. M. Conarroe, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of November was read.

The Board of Managers and Standing Committee reported their minutes.

Resignations of Membership in the Institute (5) were read and accepted.

New candidates for Membership in the Institute (5) were proposed, and the candidates (120) proposed at the last meeting were duly elected.

Nominations were made for Officers, Managers, and Auditors, for the Institute for the ensuing year.

On motion, it was

Resolved, That the polls for receiving the votes of the Members at the annual election for Officers, Managers, and Auditors, for the ensuing year, to be held on Thursday, January 20th, 1853, be opened at 3 o'clock, and closed at 8 o'clock P. M.; and that a committee of seven members be appointed to receive the votes, and report the result thereof.

Dr. Rand called the attention of the members to specimens of engravings of fossils, medal ruled, on steel, from the original specimens. The plates accompany the report of the geological survey of Iowa, Illinois, Wisconsin, and part of Missouri, by Dr. David Dale Owen, U. S. Geologist, and were executed at his suggestion, by Mr. John M. Butler, of this City. By this process, a perfect fac simile of the original is obtained. Among the specimens exhibited were engravings of trilobites, ammonites, shell conglomerate, &c., of great beauty. Dr. R. mentioned that notwithstanding the perfect accuracy and beauty of the engravings thus produced, he had been informed that their cost was less than that of lithographs, in which it is necessary to depend upon the artist for the accuracy of the representation.

[We hope to present a more detailed account of this process, illustrated, in a future number of the Journal.]

A refracting pseudoscope, (Wheatstone's,) belonging to Prof. Frazer, was exhibited to the meeting, at the request of some of the members, by G. W. Smith.

An elevation of a building to be erected in Broad street, for the purpose of a shop, on an unusually large scale, and in a highly decorated style of architecture, was exhibited by Mr. George W. Smith, and the details described by him. It was designed by Mr. McArthur, of this city, and is almost two hundred feet in length, and upwards of one hundred feet in breadth, and about eighty feet high; consisting of three stories only, and nine windows front. The lower story is decorated with Corinthian columns, after the example of the temple of Jupiter Stator, at Rome, with the full enrichments.

The following minute of the November meeting having been omitted in its regular order, is now inserted.

Mr. G. W. Smith remarked that Mr. John C. Trautwine, C. E., had recently returned from an exploration of the canal route, spoken of by

Humboldt, as existing between the rivers Atrato and San Juan, in New Granada. The first of these rivers enters into the Atlantic, and the latter into the Pacific, about 400 miles apart by the windings of the rivers. Humboldt states that their waters were once united by a canal in the vicinity of the town of San Pablo. It appears, however, that this was never the case. Mr. T. ascended the Atrato to the head of canoe navigation, where he found at times but a few inches of water, and was compelled to assist in dragging his canoe along the stream in many places. He ran a line of levels from this head of canoe navigation, across to the San Juan, near San Pablo, and found the latter to be 102 feet below the former. The summit between them is 84 feet above the head of canoe navigation, and 186 feet above the ordinary water of the San Juan. The San Juan, at San Pablo, is 150 yards wide, and at its average stage, is 5 feet deep. Mr. S. had not time to go into the details of the impediments in the way of constructing a canal, but remarked that Mr. T. considered them entirely insuperable. Mr. T. also ascended the Napipi a few leagues, until he became convinced of its inapplicability for the purposes of a canal. He also traversed the country between the Atrato and the river Baudo, in two places; and descended the Baudo to its mouth, as well as the San Juan.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Kingston Goddard's Patent Sectional Box and Axle.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Patent Sectional Box and Axle," invented by Mr. Kingston Goddard, of Philadelphia, Pennsylvania—Report:

That the nature of the invention consists in making the box in two or more parts, with a recess to receive and embrace a collar on the journal part of the axle, or, what is essentially the same, with a projecting fillet to fit into a recess on the journal part of the axle. The box is fitted to the axle by having its periphery conical to fit and be drawn into the hub, or into a pipe-box fitted to the hub, so that by simply securing the box within the hub or pipe-box, which is done by means of a nut screwed on the end of the box, the wheel is secured on the axle.

The patentee claims for this arrangement the following advantages:—

1st, Its cost of manufacture is comparatively small.

2d, It is easily adjusted to new or old wheels.

3d, Smoothness and regularity of motion.

4th, Retention of oil or grease. The oil cannot escape from the outer end of the box, as that is secured by the nut; it has no tendency to flow out of that next the body of the vehicle, and it may be still further secured by making a groove in the box near its larger or inner end to receive a grummet placed on the axles. By removing a screw in the centre of the nut, fresh oil may be applied without removing the wheel from the carriage.

5th, Safety. There can be no running of the wheel off the axle.

6th, Ease with which it can be cleaned.

7th, It excludes entirely dust and sand.

8th, Does not grease the end of the hub, and thereby saves the clothes of the rider in getting in or out of the carriage.

9th, When the box wears out, a new one, or section of one, can be substituted in a few minutes by the hostler, without sending to the coachmaker.

10th, It is equally well adapted for light or heavy carriages, omnibuses, drays, &c.

11th, It makes less noise in moving than the ordinary axle, on account of the small lateral motion and the impinging surfaces being enclosed. If desirable, leather washers may be introduced to render this still less.

12th, By the reduced diameter of the lateral bearing surfaces, it diminishes the draft, enabling a horse to travel faster and further with a heavier load and greater ease than in any other.

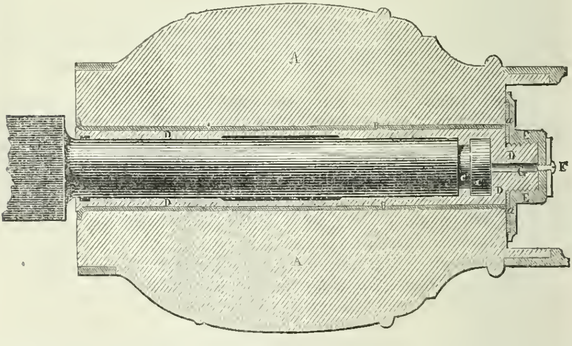
13th, No matter how careless or clumsy the hostler be, he cannot possibly tighten the box or axle, it must run smoothly.

Upon examination, the Committeee are of opinion that the invention of Mr. Goddard possesses most of the advantages above enumerated, and claimed by him. They recommend the award for the invention of the Scott's Legacy Medal and Premium.

By order of the Committee,
WM. HAMILTON, *Actuary.*

Philadelphia, Dec. 9th, 1852.

Description.



A is the hub of the wheel; B B is a malleable iron casing, fitting tight inside; C C is the angle with a groove, C′, cut in its further end; D D are separate halves of the box for the axle, which, when placed in the hub, are joined together by a nut, F, which fits on a screw; each half of the box, D D, having part of the screw cut on its end. F is another screw fitting into the aperture, G, so that the axle can be oiled without taking off the wheel, it being only necessary to take out the screw, F, for the purpose of effecting this object.

HARRISON'S STEAM-ENGINES AND BOILERS.

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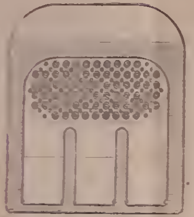

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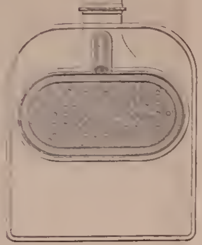

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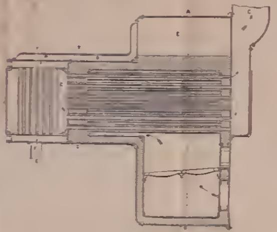

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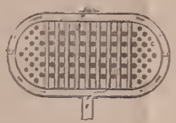

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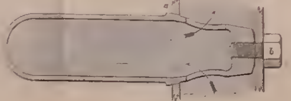

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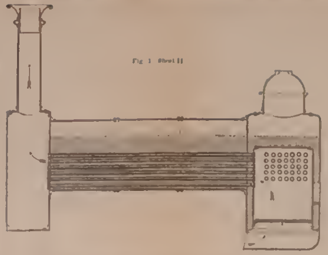

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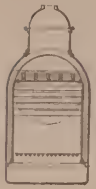

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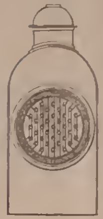

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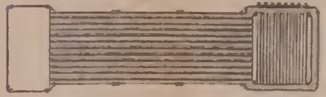

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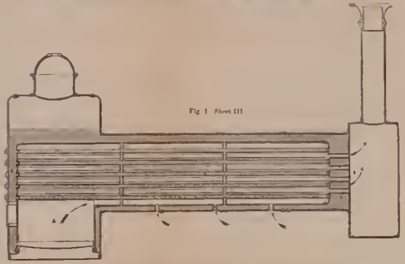

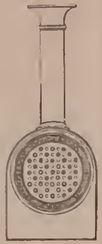

Fig 2—Sheet III

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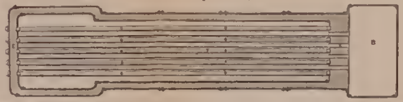

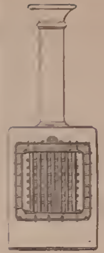

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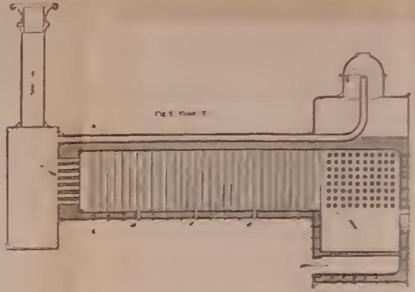

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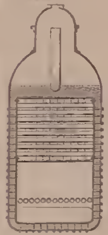

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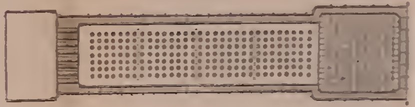

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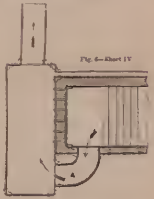

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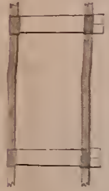

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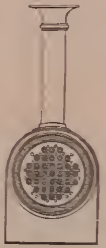

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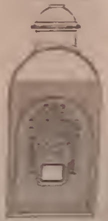

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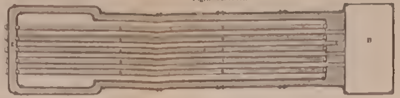

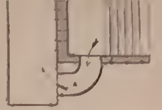

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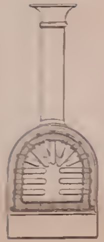

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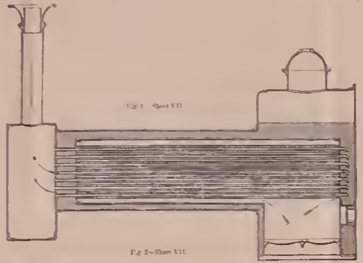

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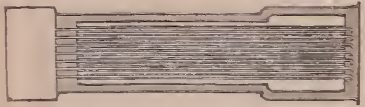

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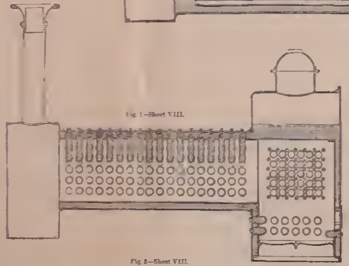

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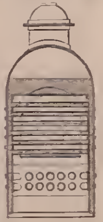

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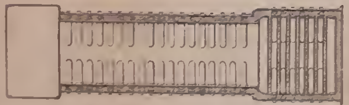


Fig. 1 Sheet VI

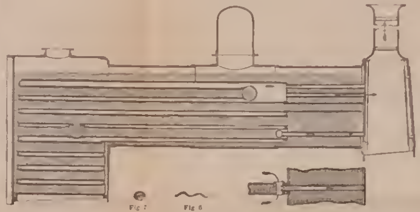
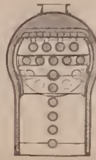


Fig. 7
Fig. 8

Fig. 2—Sheet VI



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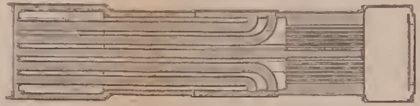
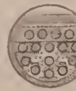


Fig. 3 Sheet VI.



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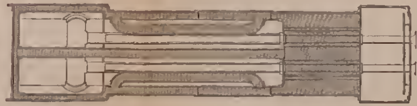

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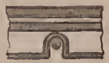
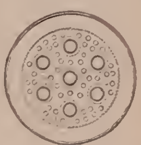


Fig. 2 Sheet V



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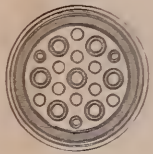

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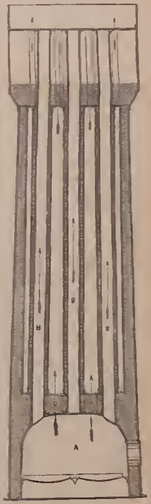


Fig. 3—Sheet IX.

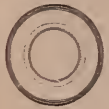
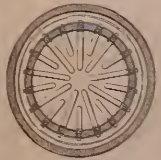


Fig. 2—Sheet IX.



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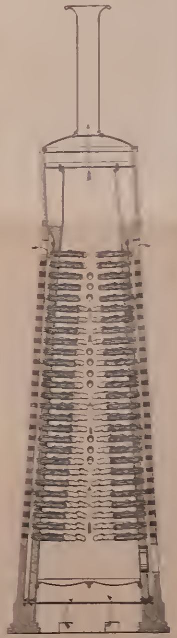

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OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

FEBRUARY, 1853.

CIVIL ENGINEERING.

On the Expansive Working of Steam in Locomotives. By DANIEL KINNEAR CLARK, C. E.—(*With a Plate.*)*

[Abstract of a Paper read at the Institution of Mechanical Engineers.]

Continued from page 11.

It is now proposed to consider the conditions on which the expansive working of steam in locomotives may be most beneficially carried out.

The condensation of steam in the cylinder by exposure, which takes place in certain arrangements of locomotives, is susceptible of proof in various ways: by the internal evidence of the indicator diagram, in respect of its general form, the form and course of the expansion line, and the back pressure; also by a comparison of the volume of sensible steam which is found to pass through the cylinder, with the volume of water found by measurement to be consumed from the tender and the boiler. The evidence of the expansion line of the indicator diagram will be first considered, both for well protected and partially protected cylinders.

Evidence of the Expansion line of the Indicator Diagram.—As the total heat of saturated steam is nearly constant for all pressures, being slightly greater the higher the pressure, there can be no condensation of steam during expansion, in a perfectly non-conducting vessel, but rather a slight surcharge. The surcharge is so slight, however, as not to require further notice in the present inquiry; we are only concerned in showing that perfectly protected steam under expansion, without any deduction from, or accession to its heat, continues substantially in a state of saturation, and unaltered in quantity or mass; and that if the indicator diagram show that at the end of expansion the final quantity of sensible steam is either greater or less than the initial quantity at the beginning, and surcharge by condensation or otherwise must have taken place in the condition of the expanding steam. The initial and final quantities, or their equivalents in water, are readily found by dividing the capacity of the cylinder and the clearance occupied by the steam, by the relative volumes due to the initial and final pressures. By the same law we may find the expansion curves, which would be described with a constant quantity of saturated steam under expansion; this has been done for the slow diagrams from No. 13, C. B., (Plate I. fig. 1,) and the curves of simple saturation thus found are shown in dotting. The deviations of these from the actual curves are all referable to one cause—*the condensation of the steam.*

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* From the London Civil Engineer and Architect's Journal, September, 1852.

In No. 1, the cylinder must have been at a lower temperature than the steam during the admission, and some condensation must have taken place, for no sooner is the steam cut off, than condensation is made visible by the sinking of the expansion curve below the standard throughout the whole of its length. In No. 2, also, this takes place to a small extent for the first half of the curve, when the temperatures of the steam and the material of the cylinder become equal; after this, as the pressure continues to fall, and the temperature of the steam with it, the curve rises and meets the standard curve at the end, in virtue of a partial re-evaporation of the steam previously precipitated, caused by the cylinder itself, which, colder than the steam, and heated by it in the first stage of the expansion, is now relatively hotter, and partially restores the heat of which it had previously robbed the steam.

In Nos. 3 and 4, the process of successive condensation and re-evaporation is still more distinctly brought out. In these cases, the greater portion of the heat engaged in the restoration of the steam during expansion must have been absorbed by the cylinder, by condensation of the steam during admission. Under the 3d and 4th notches, the observed final equivalents are shown to exceed the initial by 19 and 45 per cent. of the latter respectively; which proves that, in the two cases, at least 19 and 45 per cent. of the steam admitted *must have been condensed during admission*, as the additional steam can have been obtained from no other source. Although the actual expansion curves, Nos. 3 and 4, indicate much higher mean pressures *during expansion*, than the standard curves, and may so far be viewed as superior results, the favorable difference is only a partial amends for the much greater loss by initial condensation; and an expansion curve may be constructed backwards, in terms of the indicated mass of steam at the end of the expansion, to show from what initial pressure this mass of steam could have expanded, had there been no condensation. Take No. 4, for example. The final pressure at G is 13 lb., for which the relative volume is 939, and the ratio of the initial and final total volumes, or the degree of expansion, is 1 to 2·66; then $939 \div 2{\cdot}66 = 353$, which is the relative volume for $66\frac{1}{2}$ lb. steam at the point of suppression. Tracing the expansion curve G H for this pressure, as in the drawing, for which any number of intermediate points may be found in the same way, and drawing a horizontal admission line H I to the beginning of the stroke, the extra shaded area so inclosed is a representation of the real loss incurred by initial condensation of the steam; and, without going into figures, it appears nearly as much again as the area or power actually obtained.

The diagrams just discussed are, of course, extreme cases, which might occur in any cylinder, outside or inside; and they have been selected simply for purposes of illustration. They have served to show in what way the expansion curves of indicator diagrams may be turned to account in developing the condition of the steam. Our business is now to find to what extent, in the ordinary working of locomotives, the condition of the steam is affected by the circumstances of the cylinder.

The first point is to show, by the expansion line, that in well protected cylinders the steam is not subject to condensation. Referring to the 26 diagrams obtained from the *Great Britain*, of which the cylinders are suspended in and freely surrounded by the hot gases in the smoke-box, it appears that for each notch the influence of speed on the relation of the initial and final water equivalents of the steam expanded is nearly inappreciable. Dealing therefore with the means, the mean differences by which the final are less than the initial equivalents are—

For the 1st notch 3 per cent. of the initial equivalent.
" 3d " $5\frac{1}{2}$ " " "
" 5th " $2\frac{1}{4}$ " " "

These per centages are practically nothing, and the virtual constancy of the mass of expanding steam during expansion, thereby proved, shows that for the greatest observed degrees of expansion in the cylinder of the *Great Britain*, no change in the condition of the steam is observable, and that there is, consequently, no condensation at all.

Experiments made by the writer on some of the engines of the Edinburgh and Glasgow Railway, with inside cylinders, lead to the same conclusion.

Numerous diagrams were obtained by the writer from the outside cylinder engines of the Caledonian Railway, of which the cylinders are placed beyond the direct influence of the heat in the smoke box, and considerably exposed to the atmosphere. Seventy-six were selected as average samples of diagrams obtained during the regular work of the engines. These have been analyzed in the way adopted for those of the *Great Britain*, and the mean results range from 9 per cent. deficiency, to as much as 67 per cent. excess at the greatest expansion. Specimens of the diagrams from No. 42, passenger engine, and from No. 125, goods engine, are given in fig. 2. These diagrams were taken by McNaught's Indicator, and the dotted lines show the actual curves which are affected by the oscillation, to which that indicator is subject at high velocities. The mean lines have been drawn on the diagrams on the principle which the writer has satisfied himself applies in the particular case of the indicator—that action and re-action are equal, and that therefore the mean line, or radical form, ought to inclose the same collective area of diagram as the fluctuations in the lines actually described, due partially to momentum, cutting off at one place as much as it incloses at another.

For the greater ratios of expansion, the final equivalent of the steam is much above the initial, and the greater the ratio the greater is the per centage of this excess, amounting to 67 per cent. with an expansion of $3\frac{1}{3}$ times. This relation is just what was found for the slow diagrams from No. 13, and there is no doubt the excess of steam, at the termination of the expansion, is due to the same cause, namely—the condensation of the steam in the cylinder during admission, and during the first part of the expansion, and the subsequent re-evaporation of a portion of the precipitated steam. During the experiment, there was at all times ocular demonstration of the existence of water in the cylinder, in the spray which escaped from it through the indicator, and *which was given off more abundantly the more expansively the steam was worked.*

To find the general rate at which the per centage of condensation increases in these engines with the degree of expansion, the results obtained may be referred, as ordinates, to a base line representing the ratios of expansion. Let A B, fig. 4, be a base line divided to represent the total volumes by expansion in terms of the initial volumes; and from B draw the vertical scale to measure the relative per centages of condensation. From A set off on the base line the ratios of expansion, and for each ratio set off perpendicular distances by the vertical scale, equal to the respective per centages of the differences of water equivalents, col. 13, and define their extremities by points, setting off *minus* per centages below the line, and *plus* per centages above. The mean line C D, drawn through these points, is straight, and represents the mean rate at which the indicated condensation increases with the degree of expansion. It is found to meet the vertical from division 1, at 20 per cent. below, crosses the base line at a volume of 1·53, and terminates at E, the point due to an expanded volume of 3·4, and to a per centage of 70, and would, if produced, meet the vertical from B, at $92\frac{1}{2}$ per cent. The straightness of the line implies that the indicated per centage of condensation increases uniformly with the relative volume by expansion. For an expansion of 1·53 times, the per centage of condensation, or indicated difference of equivalents, is nothing; and, generally, for expansions advancing by half volumes, the per centages are as follows:—

Expanded volumes, the initial volume being — 1.	Indicated per centages of condensation.
1·5	— $1\frac{1}{4}$
1·53	0
2	$17\frac{1}{2}$
2·5	$36\frac{1}{4}$
3	55
3·5	$73\frac{3}{4}$
4	$92\frac{1}{2}$

For every half volume of expansion there is an increase of $18\frac{3}{4}$ per cent. of indicated condensation, and this becomes so serious that for an expansion of four times, if this were practicable with ordinary valves and link motions, there would be $92\frac{1}{2}$ per cent. of loss by condensation, or a loss of nearly one-half of the total quantity of steam admitted.

For ready reference, it is expedient to find the relative expansion and indicated condensation for different periods of admission, yielded by ordinary link motions. The following table contains in col. 2 the total expended volumes due by the nature of link motion to the several periods of admission in col. 1, and col. 3 contains the relative indicated per centages of condensation due to these expansions, measured from the diagram.

Of the Indicated Condensation of Steam in Outside Cylinders during the Admission of Steam.

Period of admission in parts of the stroke.	Total volume by expansion, the initial volume being = 1.	Indicated condensation, in parts of the indicated steam cut off.	Approximate proportion of steam condensed.	
			In parts of the INDICATED steam consumed.	In parts of the WHOLE steam consumed, (including the condensed steam.)
Per Cent.	Ratio.	Per Cent.	Per Cent.	Per Cent.
75	1·22	—12·0	12	11
60	1·40	— 5·2	12	11
50	1·54	0·0	12	11
40	1·78	9·4	21	17
30	2·07	19·9	32	24
20	2·45	34·1	46	32
12	3·17	66·1	73	42
1	**2**	**3**	**4**	**5**

Though the losses shown in the 3d column are great, the real losses must be still greater; because the restoration of condensed steam, by which the losses have been measured, cannot be entire. The indications, indeed, fail to show any loss at all, at 50 per cent., as the re-evaporation balances the condensation during expansion. For 75 per cent., the re-evaporation (if any) is so slight as to leave a deficit of 12 per cent., by condensation, during expansion, compared with what was indicated as cut off. Now, the whole tenor of the evidence shows plainly that the degree of condensation increases as the admission is shortened; and it may be safely inferred that as 12 per cent. is shown to be lost in full gear, there is at least 12 per cent. of loss for 50 per cent. of admission, cutting off at half stroke. An approximate loss of 12 per cent. will, on this ground, be adapted for all admissions greater than half stroke; and 12 per cent. will also be added to the indicated losses for shorter admissions, as an approximation to the real conditions.

Col. 4 contains the approximate losses as thus revised, in parts of the *indicated* steam admitted. Adding the *lost* steam admitted to that indicated, the sum expresses the *whole* steam admitted and expanded; and col. 5 contains the per centage of approximate loss, expressed in terms of the whole steam so used, which is a more convenient form for reference. From this column it appears that for 40 per cent. admission, 17 per cent., or one-sixth of the steam, is condensed; for 30 per cent., one-fourth; for 20 per cent., one-third; and for 12 per cent., or mid gear, two-fifths, or not far from one-half.

It must be added that the foregoing deductions are based on steam pressures under 60 lbs., generally about 50 lbs., during admission. For higher pressures, and admissions above half stroke, the condensation is proportionally less, as will afterwards be shown.

Proof of the Condensation of Steam in Outside Cylinders, by comparison of the indicated consumption of steam with the measured consumption of water.—Many experiments were made by the writer on this point; one was made with No. 42, passenger engine, on the Caledonian Railway, during a trip of 105 miles, from Glasgow to Carlisle, with an average train of 6½ carriages, done in three hours 22 minutes, five stoppages included. Indicator diagrams were taken from the cylinder at intervals of one or two miles, and the notch of the expansion gear observed for each diagram, and the points of the line where each change of notch was made.

The several points of cutting off, expansion, and compression were accurately ascertained by means of the slow diagrams; from which were calculated the exact quantities and pressures of sensible steam actually consumed in each interval of the trip, and the water equivalents for the several quantities of steam present in the cylinder; which, multiplied by the number of strokes of the two cylinders in each interval, gives the total quantity of water efficiently used as steam. The following final results were thus obtained:

Distance traveled.	Water used as sensible steam.	Water consum'd as measured.	Excess.
1. Glasgow to Motherwell, . .	30·76 ft.	35·82 ft.	5·06 ft, or 14 per cent.
2. Motherwell to Carstairs, .	43·91 ft.	48·85 ft.	4 94 ft., or 10 do.
3. Carstairs to Beattock, . .	57·28 ft.	67·74 ft.	10·16 ft., or 15½ do.
4. Beattock to Carlisle, . .	62·42 ft.	79·50 ft.	17·06 ft., or 21½ do.
Total, Carlisle to Glasgow,	194·37 ft.	231·91 ft.	37·54 ft., or 16¼ per cent.

The examination of the indicator diagrams in the manner employed before, by comparing the initial and final water equivalents of the steam during expansion, shows that at least 13 per cent. of this loss of 16¼ per cent. was due to condensation, and it is probable that no appreciable proportion was due to priming; indeed, the *least loss* was observed to take place with the least degree of expansion, and when the consumption of steam from the boiler is going on at the *greatest rate*, as we find on referring to the per centages of admission; which is the reverse of the effect that would be observed if priming were a material cause.

Experiments made by the writer with other outside cylinder engines, *or imperfectly protected* cylinders, corroborate the above deduction obtained from the performance of No. 42; and they are still further corroborated by his experiments on inside *well protected* cylinders, which show that in ordinary good condition there is no sensible excess of water of any importance, actually consumed from the boiler, above what is estimated from the indicated steam passed through the cylinder. These results are also confirmed by the results of the trials of Mr. D. Gooch, with the *Great Britain* and similar engines.

The increased *back pressure of exhaust* affords additional evidence of the presence of water in the cylinder. The back exhaust pressure is the consequence of the want of facilities for the timely discharge of the exhaust steam from the cylinder; and the impediments to its discharge are much increased by the presence of water amongst the steam, whether due to condensation or to priming. The presence of water is immediately made apparent by the increase in the back exhaust pressure, shown by the indicator diagram, as the writer has on many occasions had an opportunity of observing. The *effects of priming* from foulness of the water in the boiler are shown in fig. 3: A and B are indicator diagrams taken from the well protected cylinders of the *Orion*, in which very little, if any, condensation could be detected. The diagram A was taken *before*, and the diagram B *after* the boiler was blown off and supplied with clear water, both being taken at the same speed, and showing 7 lbs. back pressure caused by priming in the former case.

The diagrams C and D, fig.3, show that the *total quantity of water* from condensation is considerably greater, with the greater degrees of expansion, where a *smaller quantity of steam* is admitted, and consequently the loss is more seriously felt. These diagrams were taken from the outside cylinder goods engine No. 127, working at the same speed up and down an incline on the Caledonian Railway; the diagram C cutting off at two-thirds the stroke, and the diagram D at one-sixth of the stroke. The latter, D, though it had the advantage of a much earlier exhaust, and only one-fourth of the quantity of steam to discharge, was affected with 10 lbs. more back pressure than the former, C, when working in full gear. This great back pressure was maintained over a continued run of twenty miles, when of course the cylinders had got into their working heat for that degree of expansion; and the inference is, that the steam was loaded with water of condensation, (proved also by the expansion curve,) which was with difficulty expelled, and which only became proportionably less when the degree of expansion was diminished; and, consequently, the mass of steam increased that was to be cooled within the same superficies of cylinder.

That the *total mass of the steam* has much to do with the condensation is proved by the diagrams E and F, fig. 3, taken under the same degree of expansion, and at the same speed, but with 75 and 20 lbs. steam respectively admitted to the cylinder. In the latter diagram, F, the back exhaust pressure is 7 lbs. greater than in the former diagram, E, although the total quantity of steam to be discharged was so much less. In the latter case, indeed, there was found to be an excess of 18 per cent. of the whole water used over the indicated steam expended, which was most probably altogether by condensation, as the rate of consumption was so moderate as to preclude any likelihood of priming.

Now here is a case where, in the same class of engines, the back exhaust pressure *increases* as the quantity of steam to be discharged *becomes less*, notwithstanding that the facility for exhaust increases at the same time. This is clearly a case of water in the cylinder, the quantity of which increases with the degree of expansion; and the water is as clearly a precipitation of steam by condensation. Also, though a full admission of steam at higher pressures may reduce the proportion of condensation, yet whenever expansive working is attempted by cutting off earlier, the heavy back pressure and the course of the expansion line alike show that no pressure of steam, however high during the admission, can mitigate the evils of condensation in exposed cylinders.

Evidence from the Proportions of the Valve Gear.—The greater the lap of the valve, the greater also is the inside lead, for the exhaust exposed cylinder, we should expect, would therefore require longer laps than well protected ones, seeing that wet steam exhausts with difficulty. Accordingly, it has been found that in Sharp's inside cylinder engines, on the Edinburgh and Glasgow Railway, which have only a ⅝-inch lap—probably the shortest lap in present practice for a 15-inch cylinder—the exhaust is as perfect as in the Caledonian passenger engines with 1½-inch lap for the same cylinder. Further, in inside cylinders with clean boilers, it is practically a matter of indifference what amount of wear or slugger may have taken place in the valve gear, so far as concerns the exhaust: in outsides, on the contrary, it is a very important object to maintain the gearing in the highest order, so as to keep up the inside lead, as the wear of the gearing directly reduces the lead, and thereby increases the back pressure. The Caledonian is perhaps the first line in this country on which the special advantage of long lap for outside cylinders was experienced.

The formidable degree of condensation which accompanies high expansion in partially protected cylinders, accounts for the opinion held by men of experience of the inutility, for economical objects, of cutting off the steam earlier than at half stroke, for the proved advantage of expansive working in inside cylinders is neutralized in outsides by the condensation. Mr. Buddicom, of the Rouen Railway, led the way in the re-introduction of outside cylinders in this country: and to this day, he and some of his followers have adhered to the fixed gab motion.

Conditions on which the expansive working of steam in locomotives may be carried out with efficiency and success.—The first condition is to perfectly protect the cylinders, and to maintain them at a *temperature at least as high as that of the steam admitted to them.* Simple non-conducting envelopes are not sufficient; external supplies of heat must be employed, and the application of a steam jacket to the cylinder would be advantageous, when other sources of heat are not readily available. The writer tried an experiment with the *Orion*, Edinburgh and Glasgow Railway, which has its cylinders suspended in the smoke box, like the *Great Britain's*, in which, by the use of partitions, the hot air from the tubes was directed entirely round the cylinders, previously to its emerging by the chimney: but he could not detect the slightest change in the performance of the engine, probably because the hot air was really very little hotter than the steam, and the closer contact made no difference. For cylinders already well protected, more thorough modifications would be required to make a sensible improvement. The steam should also be surcharged, previously to entering the cylinder, by passing over an extensive heating surface, deriving its heat from the atmosphere of the smoke box, or, if necessary, from a hotter source.

Mr. W. C. Hare, of Stonehouse, Devon, to try the value of surcharging the steam, experimented on a small engine, with cylinder 3½ × 8 inch stroke, and a boiler of 9 feet heating surface. He found that when the steam was passed over a surcharging surface of 5¼ feet in a coil of copper tube, and heated to 400° before entering the cylinder, the consumption of water from the boiler was three gallons per hour; and when the communication with the surcharging pipe was cut off, and the steam led directly to the cylinder, the water used amounted to six gallons, or twice the other, while doing the same work, and involved a great increase of fuel consumed. To effect the reduction here noted, it appears that a surcharging surface equal to fully one-half of the heating surface has been necessary; and it is probable that for locomotives a considerable allowance must be made to produce a very decided change. The results of this experiment show that very much has yet to be done before the capabilities of the locomotive are fully developed.

As steam has been found so very sensitive to *exposure* on the one hand, and to *surcharging* on the other, it would probably be of advantage to *lead the hot smoke round the barrel of the boiler and the fire-box*, or the barrel only, *previously to its discharge by the chimney.*

The second condition of successful expansive working in locomotives is the combination of a sufficiently high boiler pressure of steam, with suitable proportions of cylinder and driving wheel, to admit of highly expansive working consistent with the required duty of the engine. It is probable that 150 lbs. per inch is about the highest pressure at which it is advisable to work a locomotive, consistent with the fair working and durability of its parts. The maximum pressure being settled, and it being assumed that the same pressure is to be maintained in the cylinder during admission, the degree of expansion to be adopted determines the capacity of the cylinder to develope the necessary average power. Long strokes are not advisable on the score of stability, at least for outside cylinders, and large diameters should rather be adopted; for the same reason, large wheels are preferable.

Thirdly, in the details of the mechanism, the cylinder should be arranged to have the shortest practicable steam-ways; as, for short admissions, a long steam-way deducts very much from the efficiency of the steam. Such an arrangement would be greatly promoted by the introduction of balanced valves, or such as have provision for preventing the steam pressure on the back of the valves; as, by being balanced, they could with facility be made large enough to embrace the whole length of the cylinder. The loads which ordinary valves are forced to carry on their backs are enormous; and though there is certainly no momentum in these loads to contend with, yet the friction of surfaces due to the loads is very great, even at the most moderate computation.

Discussion.—Mr. Stephenson (the Chairman) observed that he felt much obliged to the author of the paper for explaining in such a clear and practical manner the action of the slide valve and the link motion; and the paper was particularly valuable for the actual numerical results that were given so completely of the variations in practical working, showing the improvements effected and the defects avoided.

Mr. M'Connell agreed that the link motion was the most advantageous and useful of any valve motions known for locomotive engines. He thought a hot air chamber should be contrived, passing round the cylinders, to be kept at a temperature sufficient to maintain the steam perfectly dry.

Mr. Clark said, that in the Great Western engines, Mr. Gooch had carried the steam pipe straight down in front of the tubes, instead of curving it on one side as usual; and the pipe being of $\frac{3}{16}$-inch copper, it absorbed the heat from the tubes rapidly, and surcharged or dried the steam.

Mr. Stephenson observed, that with regard to the question of surcharging steam, he remembered being told by Mr. Trevithick of an experiment which he made in Cornwall in 1830. He had to repair an old engine there, which had no steam jacket to the cylinder, as most of the other engines had, to keep up the pressure of the steam; and he built a brick casing round the cylinder, leaving an air space all round, and applied a small fire to keep this air heated. About one bushel of coals in twenty-four hours was consumed in heating the cylinder, and he found a great increase was effected in the duty performed by the engine, with the same consumption of fuel under the boiler as before. He then removed the fire from the cylinder, in order to find the relative efficiency of the coal when consumed under the boiler or under the cylinder, and he found that it took five bushels of coals applied to the boiler to produce the same effect as the one bushel of coals applied to the cylinder. Mr. Stephenson said, he had been so much impressed with the results of this experiment, that in the *Planet*, one of the early locomotives made in 1832, he had the cylinders carefully inclosed inside the smoke box, instead of being outside, and there was found to be a considerable increase of power effected by the plan. That was the first locomotive constructed with heated cylinders, and it appeared the principle ought never to have been deserted; but it was singular how temporary prejudices sometimes caused a good thing to be departed from. Those inside cylinders were abandoned because the crank axles were found liable to break; but then, after that objection was subsequently removed by improved manufacture, the prejudice against the inside cylinders still remained; however, they appeared now to be going back to them. The construction of locomotives was still perhaps much influenced by these local prejudices arising from individual circumstances; and he was confident that this Institution would conduce greatly to the removal of them, by the mutual interchange of ideas and experience that was promoted by it; and nothing could assist more in forwarding such a desirable object than the reading of such papers as the present one by Mr. Clark. He quite agreed with the opinion stated in the paper on the great drawback to the application of expansion in locomotive engines caused by the condensation, from the cylinders not being heated; he considered some additional heat was required to be supplied during expansion to prevent condensation taking place, as it appeared the quantity of heat in steam was not sufficient to maintain the whole in the form of steam during expansion, but a portion returned to the form of water, as shown in the able investigation of the expansion of steam given in Lardner's "Treatise on Heat."

Mr. Cowper described some experiments that had been made by Mr. Siemens and himself, which he thought showed that condensation did not take place during expansion. They took a cylindrical tin vessel closed at the top, about 12 inches high and 2 inches diameter, the metal of which was very thin, and coated thickly with felt outside to prevent any loss of heat. A small steam pipe was connected at the top, but the bottom of the cylinder was open to the atmosphere; and a stream of 30 lb. steam was blown into the vessel from a very small orifice, and allowed to escape freely into the atmosphere at the open end of the cylinder. After a short time, when the cylinder had become hot, and was maintained just full with expanded steam at the atmospheric pressure, a thermometer inserted a short distance into the open end, showed a constant temperature of 214° to 215° instead of 212°, proving the total quantity of extra heat that is in high pressure steam; and no condensation could be perceived inside the cylinder, no vapor being visible until the steam had escaped from the cylinder into the atmosphere. This experiment was tried on several different occasions, and on one it happened that the boiler was priming slightly; and when a drop of water came over through the steam pipe and dropped upon the bulb of the thermometer, it was observed to fall suddenly to 212°, and remained at that point until the water was boiled off, when it again rose 2° to 3° above the boiling point as before.

Mr. Stephenson said he did not think that mode of trying the experiment would give a correct result as regarded the present question, as the steam was escaping into the atmosphere instead of being all confined within the cylinder, and the temperature in the cylinder being maintained above the boiling point would prevent any condensation taking place during the expansion of the steam.

Mr. Cowper did not think that in a cylinder thoroughly protected from loss of heat by radiation or conduction, any condensation of the steam would take place during expansion, and that if any condensation occurred, it would be found to be owing to the steam having lost some of its heat, which it could not recover. The result that he obtained by indicator diagrams from a pair of 35-horse power, high pressure, expansive, and condensing engines, which he had constructed some years since, fully bore out this view; the steam was expanded in the cylinder of each engine independently, and the practical expansion curve was obtained very accurately. The whole body of the cylinder was necessarily nearly at a mean temperature between the highest and lowest steam in the cylinder, (the cylinder not having a steam-jacket,) consequently the steam ought to be slightly cooled on entering the cylinder, and towards the end of the stroke, where it was at a lower temperature from expansion, it ought to be slightly warmed by the cylinder;—now the indicator figure showed both these circumstances to have taken place, for the actual curve during the first part of the stroke, after the steam had been cut off, was rather below the true expansion curve; and during the latter part of the stroke, it was rather above; this also showed that the expansion curve required a slight correction for the extra quantity of heat in the high pressure steam.

Mr. Clark remarked that he had found by the indicator diagrams that a great condensation of the steam took place in exposed outside cylinders during the first part of the stroke, from the coldness of the cylinders, and a considerable amount of condensation also was caused even in protected cylinders, where they were not artificially heated by exposure to the hot air in the smoke box, because the temperature of the mass of metal in the cylinder remained about the mean temperature of the steam whilst expanding in the cylinder, which might be many degrees below the original temperature of the steam on entering from the boiler. This caused the actual pressure of the expanding steam to be below the theoretical pressure during the first half of the stroke, as shown in the indicator diagram, fig. 3; where the theoretical curve of expansion is shown by the dotted line BCD, allowing for the contents of the steam port and the clearance represented by the space AA. But about the middle of the stroke, the two curves coincide at C, as the steam was then at its mean temperature, and agreed with the temperature of the cylinder; and after that point, as the steam continued to expand and lower in temperature, the cylinder remaining nearly constant was hotter than the steam, and returned some of the heat it had robbed from the steam, re-evaporating more and more of the water that had been condensed, and raising the curve of actual pressure above the theoretical curve at the end D, where the exhaust commences. A portion of the lost steam is thus restored to the second half of the stroke, but a serious loss of power still remains; and the consideration of this action that is always going on to a greater or less extent in the cylinders of locomotives, however well they may be protected, except where they are artificially heated, shows what an important source of economy is to be found in carrying out that principle.

Mr. Crampton thought that enough attention had certainly not been paid to the condensation in the cylinders of locomotives at slow speed; he did not think it was of so much importance at high speeds. It was also particularly of importance in steamboat engines, where the question had not received so much attention as it deserved. He remembered an experiment which showed a remarkable effect of condensation; four condensing engines, of equal size, were working coupled together in a boat, with the steam cut off at one-quarter of the stroke and expanded; two of the engines were then disconnected, and the other two engines were worked, cutting off at half-stroke, using, consequently, the same quantity of steam as the four engines did, cutting off at one-quarter of the stroke; but a greater effect was found to be produced by the steam than when it was used in the four cylinders. This increase of effect appeared to be entirely due to the greater amount of condensation that took place in the four cylinders than in the two cylinders. There were no steam jackets, only ordinary clothing on the cylinders, and he thought much improvement was required in this respect in marine engines, and it was a matter well deserving the consideration of engineers. In reply to an inquiry, he said the boilers were working with salt water, but he did not think that would affect the result.

Mr. Peacock suggested, that part of the effect in the experiment mentioned by Mr. Crampton might have been due to the smaller amount of friction in the two cylinders than in the four cylinders, when giving out the same total amount of power.

Mr. Crampton replied, that a greater effect was found to be produced after allowance was made for the friction, by taking indicator diagrams, and the relative consumption of the water.

Mr. Whytehead thought the loss by back pressure would also be less in the case of the two cylinders than with the four.

For the Journal of the Franklin Institute.

To the Committee on Publications.

Gentlemen:—In looking over the December number of the *Practical Mechanics' Journal* for the past year, I see published therein the specification of a new Express Locomotive, recently built for and put in operation on the London and North Western Railway. In some remarks appended to the specification, some stress is laid upon certain improvements in the mode of constructing the boilers, alleged to have been made by Mr. McConnell, the designer of the locomotive in question. By referring to the annexed specification of a patent for improvements in steam boilers, granted to me in England more than a year ago, and which I would request you to publish entire, with this letter, it will be seen that the extension of the fire box into the waist of the boiler, upon which the merit of Mr. McConnell's boiler mainly rests, is not new with him. Nor is the idea new with myself, as I am aware that this same thing has been done in this country nearly fifteen years ago. It was also the subject of a patent in England, granted to Stubbs & Grylls, in August, 1846. In both the above cases the plan was abandoned as not useful, and in my opinion failed, from not carrying out the principle far enough. Whilst I was engaged in preparing my specification in England, in the autumn of 1851, and winter of 1852, two locomotive engines were altered under *my special direction*, by Mr. McConnell, at the workshops of the London and North Western Railway at Wolverton. One of the above engines was put in operation early in 1852, and *to my certain knowledge before the new express engines were commenced.* Upon the eminent success of these altered engines, the boilers of the new engines were prepared, the latter being identical in principle with the former, although somewhat changed in form. I have for many years past been satisfied that the use of such long tubes as are now prevalent in the construction of locomotive boilers, has been, and is, an error in principle, and I think the results which are now being brought out in England, prove my opinion correct. I believe fully, that tubes of ten to fifteen feet in length, as now so extensively, and I might say exclusively, used, will be eventually abandoned for those of half the length, or even less.

I remain, gentlemen, yours, very respectfully,

Joseph Harrison.

443 *Arch Street, Philadelphia, Jan.* 17, 1853.

Specification of Improvements in Steam Boilers. By J. Harrison, Eng.

To all to whom these presents shall come. I, Joseph Harrison, engineer, of the City of Philadelphia, in the United States of North America, but now residing at No. 10 Oxford Square, Hyde Park Gardens, in the County of Middlesex, send greeting: Whereas, Her Most Excellent Majesty, Queen Victoria, by her letters patent, under the great seal of the United Kingdom of Great Britain and Ireland, bearing date at Westminster the eighth day of December, in the fifteenth year of her reign, did, for herself, her heirs and successors, give and grant unto me, the said Joseph Harrison, her especial license, &c., &c.

Marine Boiler.—Chapter the first. Figures No. 1, 2, 3, and 4, sheet

No. 1, show an arrangement of boiler more particularly adapted for Marine Engines. This boiler, in general appearance externally, is not different from boilers now in use, but it will be seen by inspection, that the arrangement of the heating surface varies from the usual mode, these variations having been made with a view to obtain a more efficient kind of fire surface as well as to increase this surface without enlarging the size of the boiler. By reference to figures 1 and 2, it will be seen that the fire box is carried forward from the fire-place some distance into the interior of the boiler, to which it conforms in shape, and is surrounded with a water space, as shown in figure 3, sheet No. 1. The open space in the fire box above the fire is filled at certain intervals with horizontal tubes distributed as shown in figure 1, leading from the water space immediately over the fire doors to the extreme end of the part of fire box extending into the boiler as above described. These tubes have water covering their interior surfaces. After the flame and combustible gases have passed from the fire upward and through the intermediate spaces between the tubes just mentioned, it passes onward through a series of smaller tubes which lead from the external fire box to the smoke chamber C through the water space B. The smoke chamber C has a series of vertical tubes so disposed as to leave the tubes leading from the fire box free for cleaning from the front end of the boiler. The heating surface in the smoke chamber is arranged so that it may be used either for generating steam by surrounding it with water, or the water from the boiler may be shut off by shutting the holes leading from the water space B to the jacket of smoke box if required. In the latter case the smoke chamber is intended to be used for drying or surcharging the steam previous to its entering the cylinders of the engine. For which purpose the steam pipe D, figures 2, 3, and 4, sheet 1, may be arranged so as to bring the steam from the steam chamber E to the top of the smoke chamber, from whence it is brought in contact with the interior heated surfaces of the smoke chamber, and is discharged in its way towards the cylinders at the opening F, figures 2 and 4. Or the opening F, figures 2 and 4, being closed, and the surface of smoke box and interior vertical tubes being filled with water and used for generating steam in like manner with the other parts of the boiler, then the steam pipe D serves as a means of conveying the steam from the top of smoke box to the steam chamber E. After the combustible gases from the fire box have been brought in contact with the interior surface of the smoke chamber and the vertical tubes contained therein, they return again to the back end of the boiler through a series of tubes which lead from the smoke chamber to the chimney G, passing through the entire length of the series of tubes first alluded to in this description, as shown in figure 2, longitudinally, and in section in figure 1. Figure 5, sheet No. 1, shows a mode of making a fire box or boiler stay, which is intended to be used in the boiler just described, as well as in all the other arrangements of boilers hereafter to be mentioned in this specification. In place of the ordinary screw stay for connecting the exterior to the interior parts of the furnace or fire box, it is proposed to make a stay similar to fig. 5, sheet No. 1, which is fully explained at a single view in section. This stay consists of a wrought or cast iron tube, or of any metal of any given diameter and length suitable to the place in which it is designed to be put; one end of this tube is closed so as to present a rounded end, the form, however, not being deemed essential. The contrary end which forms the stay is turned conical at the point A, and is made to fit steam-tight into a corresponding conical hole in the interior of the furnace, either above or in the vicinity of the fire. After passing through the interior sheet of furnace, this tube is prolonged until it reaches the interior side of the external sheet of the boiler or fire box. Directly opposite this tube a hole is bored through the exterior plate to allow a bolt to pass through, so as to draw the tube tight into the conical hole, thereby connecting the inner and outer surface of fire box, and making a secure stay. Free circulation is made into the interior of this stay by two or more holes made through the portion of the tube in the water side, which permits free ingress of water and egress of steam in the direction of the arrows. The object in making the stay in this form is to secure the very efficient fire surface surrounding the part which extends into the fire box, and at the same time to make a secure stay removable at pleasure without difficulty by simply unscrewing the bolt *b*, a matter of much importance in boiler repairs. The use of such a stay enables the boiler to be more thoroughly cleaned by taking them out occasionally at the points where mud or other matter is most likely to collect. It will be seen that the tubular stay above described does not differ so far as it is used for increasing fire surface from the "teats," well known and long used, the improvement consisting only in the mode of putting them in, so as to make them act as a stay.

Locomotive Boilers.—Chapter the second. Sheet No. 2, figures 1, 2, and 3, show a boiler as at present used for locomotives, with certain additions for increasing the fire surface in the fire box. These additions consist in using the tubular stay wherever it is practicable, which has been alluded to in the description of Marine Boiler, and in placing a series of tubes filled with water across the fire box above the fire, and disposed in the manner shown in figures 1, 2, and 3, sheet No. 2. A series of screw plugs opposite each tube will enable them to be cleaned or taken out, if necessary. These tubes may be placed in the intermediate space between the present stays. The ordinary stays may be removed, and the new arrangement of tubular stay used between each of these cross tubes, and at any other parts of the fire box, either above or around the fire, where it may be deemed necessary. This arrangement of cross tubes may be applied, as well as the tubular stay, to any locomotive boiler now in use, thereby increasing the fire surface to a very considerable extent at the part where it is most efficient.

These improvements may also be with equal advantage applied to marine or other boilers, at any parts of the fire box or flues where it would be advisable to increase the fire surface; and it is so intended to apply them to any boilers now in use, or which may be hereafter made, upon the principle now generally in use. Sheet No. 3, figures 1, 2, and 3, show an arrangement somewhat similar to the mode of constructing marine boilers as previously described. In this case also, the external form of locomotive boiler is precisely similar to those generally in use; the variations being in the mode of getting fire surface in the interior of the boiler and fire box. The fire box is again extended forward, as in the instance of the marine boiler, cylindrical in form, as shown in section figure 3, until it reaches within such distance of the tube sheet at the smoke box, B, as may be deemed most desirable. A series of tubes, D, D, D, D, figures 2 and 4, containing water leading from the back water space, F, figures 2 and 4, to the front water space, E. These tubes are so disposed as to let the flame and combustible gases from the furnace, A, pass between and around them in their journey forward to the end of the internal cylinder, which, after reaching the heat that may still remain unabsorbed, passes out through the tubes, C, C, C, C, figures 2 and 4, which run through the water space, F, F, into the smoke chamber, B, and up the chimney in the direction of the arrows. For the purpose of supporting the tubes, D, D, D, D, it is intended, if necessary, to connect each row vertically as shown in figures 1 and 2, sheet 3, with a small pipe or pipes connected with the water space, surrounding the interior cylinder, thereby adding to the means of circulation, and at the same time supporting the longitudinal tubes. By experiment, it is found that these tubes, D, D, D, D, may in most cases, be made so short that no stay or support will be needed, whilst at the same time, a sufficiency of surface can be brought in contact with the fire to effectually take up all the heat that may be generated. The faint lines in figure 3, sheet 3, show the arrangement of short flues leading through the water space, F, F, figure 2 and 4, into the smoke chamber, B. For sustaining a more perfect combustion of the gases that pass from the fire, holes are made at G, G, G, G, figures 2 and 4, sheet 3, so as to let in at pleasure, a certain amount of pure air, which will become partially heated in being allowed to circulate between the sheet iron jacket and the boiler, before entering the tubes, G, G, G, G, G. Another method for heating the fresh air before entering the cavity of the boiler, and applicable to this boiler, will be hereafter described. Sheet 4 shows an arrangement of locomotive boiler, somewhat different from the one last described; this boiler has the same arrangement of cross tubes in the fire box above the fire, as is described in the specification of boiler, on sheet No. 2, and it is intended to have the tubular stays in the same manner as the boiler just alluded to. It has the middle or waist part of the boiler between the smoke box and fire box made square, with the corners slightly rounded, as shown in section, figure 3, sheet 4. The fire box is extended forward, also of square form, with regular water space surrounding it within; it reaches within a short distance of the tube sheet, at the smoke chamber. Instead of the horizontal tubes filled with water, as in two of the former descriptions, the interior chamber forward of the fire box is filled with vertical tubes containing water so arranged as to allow the flame from the fire to pass in between and amongst them, until it reaches the forward end, when it passes off into the smoke chamber through a series of tubes surrounded with water in the same manner as described in, and shown on, sheet No. 3, fig. 5, in section. The arrangement of vertical tubes, figure 6, sheet 4, shows an arrangement of this boiler, wherein the tubes leading into the smoke chamber are dispensed with, the smoke being carried off through the curved flue, A, into the smoke chamber. If it is required, the square part of the prolonged fire box may be carried entirely into the smoke chamber, and the entire intermediate space filled with the vertical or cros tubes, thereby dispensing with the short flues leading into the smoke chamber, as well as with the curved flue last described. Figures 1 and 2, sheet 4, shows the lower part of fire box for a locomotive boiler, made like the ordinary marine boiler, thereby dispensing with the usual ash pan, and admitting a simple mode of making a water grate, by introducing tubes lengthwise or crosswise of the fire box, filled with water and connecting the opposite water spaces of the fire box. In this arrangement, it is intended to put the boiler together with screw bolts, that the back fire box may be easily removed, after which, by removing the stays and short tubes in front, the whole interior fire box may be taken out for repairs. Figures 2, 3, and 6, show the same arrangement of steam pipe, as is shown in the drawings for the marine boiler. Sheet 7 shows an arrangement of boiler, suited to the present form of locomotives generally, similar to the arrangement shown on sheet No. 3, with the single difference of passing a portion of the flame or combustible gases through the tubes containing water, by means of the tubes with the bent ends connecting with the back plate of furnace, and leading from thence into the smoke chamber. Sheet 8 shows another modification of the locomotive boiler. In this instance, the fire box is extended into the forward part of the boiler without interruption, until it reaches the smoke chamber, making a clear open space, or single flue, half round at the top, straight sides and bottom, with rounded corners. To obtain the necessary amount of fire surface in this boiler, the whole interior surface is studded at regular intervals, with tubular stays of such length and diameter as may be found most convenient, and so distributed as to bring the greatest amount of surface in contact with the flame or heated vapor, previous to its reaching the smoke chamber. It is intended to put this boiler also together in such a manner with bolts, as will enable it to be taken apart without difficulty, after taking out the tubular stays. Sheet 6, figures 1, 2, 3, 4, and 5, shows a slight modification in the mode of arranging the water pipes in the interior of a locomotive boiler. In this case, the tubes or pipes containing water, are made much larger than in any previously described; and by inspection of the drawing, it will be seen that the mode of attaching the ends of the tubes is slightly different, which, instead of passing from end to end of fire box, are in some cases attached to cross pipes in the fire box, and in others are bent at right angles, and attached to cylindrical part of fire box. Sheet 6, figure 1, shows a mode of putting in the inside flue so as to take the flame at any point of the tube containing water that may be deemed most advisable. A small tube, flattened on one side, is put across the tube containing water, into which the cross tubes are fixed, the smaller flue leading to smoke box. Sheet 6, figure 5, shows an arrangement for introducing atmospheric air into the fire box, and for heating it before it is allowed to mix with the combustible gases evolved from the fire; two or more pipes of cast or wrought iron, or of fire clay if necessary, are placed within the fire box, as shown in section. At figure 4, sheet 6, extending forwards to the tube sheet, fitting closely to the tubes that come opposite to them; pipes are fitted to the tubes leading through the smoke box to the external air, which are furnished with funnel shaped mouths, so that the forward motion of the engine, as well as the vacuum caused by the escape steam, will cause the air to pass with great velocity through the pipe across the smoke chamber, and through the tubes leading from the smoke chamber to the fire box, and into the tubes placed in the fire box. By passing through these last mentioned tubes, which will be highly heated, the atmospheric air will become also heated, and when mixed with the combustible gases within the fire box will cause a much more perfect combustion of the smoke and gases than could take place without the introduction of fresh atmospheric air. By this arrangement of introducing heated air in connexion with the peculiar form of fire box, whereby more space is given for combustion, and a consequent better mingling of the oxygen with the gases, coal may be burned without inconvenience from smoke, in locomotives, thereby causing great economy in fuel. It is usually intended to make the prolongation of the fire box cylindrical in form, and to prevent it from crushing by external pressure it may be made corrugated, as shown in section, sheet 6, figure 6; by this means, all stays between the inner and outer cylinders may be dispensed with, excepting a few to support the inner cylinder in its place.

Stationary or Chimney Boiler.—This is an arrangement of boiler, as shown in sheet 5, figures 1, 2, and 3, which is intended to accomplish a more perfect combustion of the fuel used, and a consequent consumption of a greater portion of the smoke, and at the same time, to dispense with the very expensive towers now used as chimneys. Figure 2, sheet 5, shows a vertical section of chimney boiler; it is made of circular form throughout, for more facility in making, and for greater strength, although it may be made of any form deemed most advisable. The flame and combustible gases from the fire box or furnace, A, ascend, and in part pass off through the flues, B, seven in number, as shown in figures 1, 2, and 3, and through the three smaller flues, C, figure 3. The remaining portion of flame, &c., pass from the fire through the short flues, D, figure 3, into the upper chamber of boiler, as shown in figure 2, coming in contact in their passage to the top of the boiler with the external surface of the seven vertical tubes, through which the flues, B, pass, as well as in contact with the three vertical tubes through which the flues, C, pass. The flame and gases, after they reach the top of the inner chamber of the boiler, are carried out to the external air through a series of small flues leading from the roof of the interior chamber to the extreme top of the boiler. For a more perfect combustion of the gases in the upper chamber, a series of jets of pure air may be admitted at convenient points through the outer diameter of boiler. It is intended to surround the boiler with a casing, leaving a small space between it and the exterior surface of the boiler. The air being taken from the space just mentioned will be partially heated before entering the boiler, and consequently better adapted for aiding the combustion of the gases which may have passed off from the fire into the upper chamber. At any part of this boiler, either in the fire place, or upper chamber, where a stay may be needed for connecting the inner to the outer plate, it is intended to put one of the tubular stays heretofore described, unless there should not be room for the projecting end. Sheet No. 9 shows another modification of the chimney boiler. In this case the boiler has a clear passage to the external air at the top. It is made circular in form for greater strength; the form, however, not being deemed essential, with an enlargement of the top for steam room. To absorb heat from the flame and gases which pass upward from the fire, the interior of the boiler is studded with tubular stays, so arranged as to bring the greatest amount of fire surface in contact with the flame, previously to its reaching the top of the boiler. This chimney boiler may be made square or oblong in its cross section, in which case the tubular stay may be used for increasing fire surface, or if necessary, the whole interior may be filled with cross tubes filled with water. In like manner, the boiler, if of circular form, may be filled with cross pipes, disposed as may be most convenient for accomplishing the desired end. The chimney boiler is intended to be put together with bolts at bottom, so that the interior may be taken out if necessary, for repairs, or for cleaning interior surface from mud, &c.

In the foregoing description of various forms of boiler, it will be manifest that an effort is made to apply the main portion of heat to the external surface of tubes filled with water, instead of allowing the flame and gases to pass through small tubes, as is now generally used in locomotive as well as marine boilers. It is very obvious that the more the combustible gases evolved by the fire are kept in connexion, the greater the chances of active combustion; whereas, by a very simple experiment, it will be found that combustion cannot be kept up to any great extent in a small tube, say from 1½ to 2½ inches diameter, except for two or three feet after the flame first enters from the fire place. Beyond four or five feet, it is very doubtful whether it is worth while to carry the dead weight of tubes which are now used in the boilers of locomotive engines. By putting water inside the tubes instead of around them, the mass of combustible gases are connected together by being distributed between the tubes, and thereby a better combustion takes place, which may be to a great extent improved by letting in atmospheric air into the fire box above the fire and amongst the tubes in the manner heretofore described in this specification, chapter 2d.

Figures 1 and 2, sheet 4, show a second time the mode of putting on the back sheet of fire box with screw bolts, and planed surface or packed joint, so that it may be taken off at pleasure, by taking out the stay bolts, which give greater facility for repairs and cleaning, whilst at the same time it permits the entire fire box to be taken out as soon as the stays and the series of small flues leading to smoke chamber are removed, whenever these flues are used. Sheet 6, figure 7, shows in red lines, a mode of protecting the upper surfaces of the tubes or other portions of the boiler which contain water, and in which, from the great quantity of steam bubbles which may be thrown against these surfaces, there is danger of the water being driven away from them, causing these portions to be thereby burnt. To remedy this evil, I cause to be placed in the upper portion of each tube containing water, or at any other point where the same difficulty is likely to arise, a thin metal shield, curved in such a manner, and fitting so closely as to intercept a great portion of the ascending steam, and leading it off towards the end of the water tube, or in other portions of the boiler not tubular, away from the points of fire surface, where danger might be apprehended by the water being driven away. By extending these shields through the entire length of the water tube, and through to the front tube sheet at the smoke box, and by perforating the curved surface of the shield with holes, the steam will be discharged in rapid currents upwards, and between the series of flues leading from the fire box to the smoke box, which current will tend in a great degree to keep the flues just mentioned, from being coated with mud, or other incrustations.

What I claim as my invention in the above described specification, and which I desire to secure by letters patent, is as follows:

Firstly. In extending the fire box into the boiler in the manner hereinbefore in this specification, and by the said drawings, substantially described.

Secondly. In connexion with such extension, the placing in the fire box and extension thereof, a series of horizontal, vertical, or diagonal tubes or pipes containing water, and either using the ordinary flues much shortened, (thereby saving useless weight,) leading from the fire box to the smoke chamber, or not, as may be deemed best, arranging the parts in the manner described, or in any other manner substantially the same as hereinbefore and in the said drawings described.

Thirdly. The using and adapting the "teats," well known to boiler makers, in such manner as to form tubular stays of cast or wrought iron, or any other metal for obtaining fire surface in the fire box, or any other part of a steam boiler, and at the same time making a secure connexion (easily removed) between the inner and outer plates of boiler, as substantially hereinbefore described, and more particularly shown in figure 5, sheet 1.

Fourthly. The applying tubes or pipes of any given diameter, filled with water above the fire in the fire box of locomotive or other boilers now in use, and as they are now generally made, substantially as hereinbefore described, and more particularly shown in drawings on sheet No. 2.

Fifthly. The use of return flues leading through the horizontal water pipes, as described in marine boiler, as well as the inner flues leading through the water tubes of locomotive boiler, to carry off a portion of the gases to the smoke chamber, so as to present a double heating surface to the water contained in the water tubes, whether these flues are made to pass through the whole length of water tube or not, or made so as to receive the gases at any point throughout the whole length of water tube, substantially as hereinbefore described, and more particularly shown in sheet No. 7.

Sixthly. The construction of the chimney boiler, substantially as hereinbefore described in drawings 5 and 9, including the various modes of obtaining fire surface by the use of vertical water pipes with or without inside flues through them, or by filling the interior chamber above the fire, with "teats," serving the double purpose of giving fire surface, and making a secure stay, or with cross pipes, either in connexion with the short flues at top of boiler, or not, described and shown in drawings Nos. 5 and 9, as may be deemed best, and not confining myself to any particular form of boiler or mode of arranging said pipes, flues or tubular stays, so long as the principle is substantially the same as hereinbefore described and shown in drawings, sheets Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9.

Seventhly. I also claim in connexion with the extension of the fire box into the body of the boiler, the introduction of metal or clay pipes, as shown in sheet 6, figures 4 and 5, and hereinbefore described, for the purpose of heating the fresh supply of atmospheric air that may be introduced into the fire-box, and for distributing this air amongst the combustible gases evolved from the fire, so as to cause a better consumption of the fuel and a consequent consumption of the smoke where coal is used, either in locomotives or stationary engines I do not mean to confine myself to any particular mode of letting in the air above the fire, nor to any particular mode of arranging the air pipes, which I propose to place in the fire box, so long as the principle remains substantially as hereinbefore described and shown in the said drawings, and although these air heating pipes are only shown in sheet 6; still, I mean to apply them to any and all the boilers described hereinbefore in this specification, or in other forms of boiler, and wherein the same principle can be introduced, and substantially in the manner hereinbefore described.

By forming a locomotive boiler with the prolongated fire box, advantage may be taken to indent the under side of boiler, as shown in sheet 6, figure 8, as to let the axle clear, whilst the centre of gravity of the engine is lowered in a corresponding degree, this being prevented in the usual form of boiler on account of the tubes being in the way of such indentation.

In witness whereof, I, the said Joseph Harrison, have hereunto set my hand this 11th day of February, 1852.

JOSEPH HARRISON.

For the Journal of the Franklin Institute.

Chesapeake and Delaware Canal Wheel for Raising Water.

The elevating wheel put up at Chesapeake City, at the commencement of the past canal season, presents some features worthy of note. It was constructed for the Chesapeake and Delaware Canal Company, by Merrick & Son, of Philadelphia, and was designed to supply water to the canal from Back Creek, (a tributary to the Elk River,) which communicates with Chesapeake Bay. The constructors guaranteed that it should raise 200,000 cubic feet of water per hour, with a consumption of 560 pounds of anthracite coal.

The wheel is 39 feet diameter and 10 feet in width, having iron centres and rims or "shroudings," with wooden arms and buckets (twelve in number), the latter having curved backs, so made as to take up the water easily; the inlet openings are in the periphery, extending entirely across it, and the discharge openings in each side, near the centre of the wheel. Toothed segments, forming spur wheels 39 feet diameter at pitch line and 11 inches face, 3¼ inches pitch, are bolted, one on each rim, and gear into two pinions 4 feet diameter, keyed to the fly wheel shaft of a condensing beam engine, the cylinder of which is 36 inches diameter and 7 feet stroke. At the usual speed of the engine (24 revolutions per minute) the wheel makes $2\frac{46}{100}$ revolutions, and delivers the contents of 29½ buckets. The "dip" of the wheel is maintained at 1 foot 8 inches by gates between the creek and feeding sluice, which are regulated by floats. The height between levels of water in sluice and discharging canal is 17 feet 3 inches. The total height to which the water has to be carried cannot be exactly estimated, from the fact that the buckets do not finish discharging until they pass the vertical centre line of the wheel; it is, however, very near 18 inches more, and may be so assumed, without much error—giving for the total height 18 feet 9 inches. No water goes off in the descending buckets, except that adhering to the sides.

Steam is supplied from four 42-inch boilers, 50 feet long, and is usually cut off at one-fourth the stroke of the piston. Heating surface, 1100 square feet.

The engine and wheel have been in successful operation for about six months, until the canal closed. Prior to its acceptance by the Company, it was tried on the 12th to 17th July, when the work done and coal consumed, with other data, were carefully noted. The following results were obtained on this trial, which lasted 78½ hours:

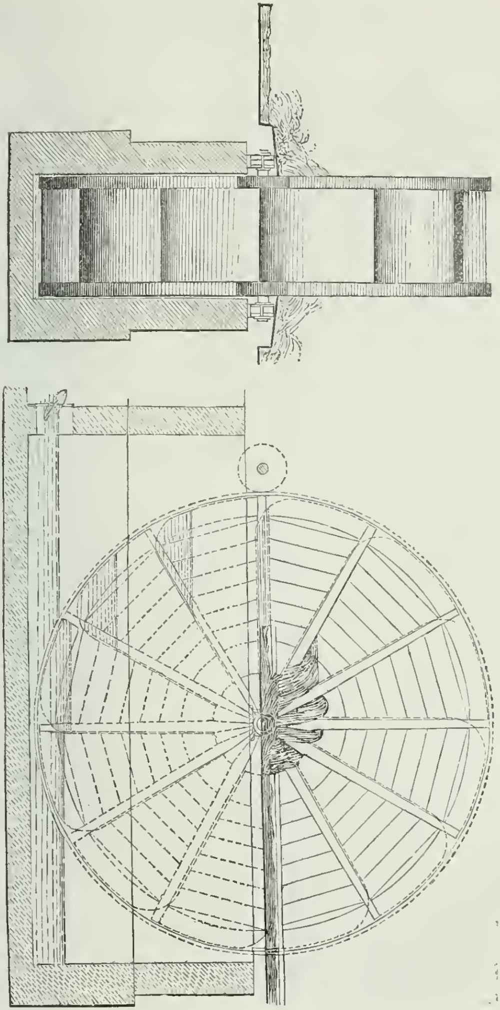
Average pressure of steam in steam chests, 52½ lbs. per square inch; vacuum, 23 inches of mercury; total coal consumed, 21½ tons = 613 lbs. per hour; quantity of water discharged per hour, 227,160 cubic feet, or at the rate of 539 pounds for 200,000 cubic feet; the useful effect produced was therefore 200,000 × 62½ = 12,500,000 pounds raised 17¼ feet = 215,625,000 pounds raised 1 foot high by the consumption of 539 pounds fuel, or per pound fuel, 400,046 pounds of water, and per bushel of coal (94 pounds) = 37,604,324, or 37½ millions. The absolute effect produced, assuming the height raised at 18 feet 9 inches, would be

$$\frac{37,604,324 \times 18\cdot75}{17\cdot25} = 40,707,050,$$ or a duty of 40¾ millions.

It is intended during the coming season to take indicator cards from the cylinder, while the wheel is in operation, in order to determine the ratio of power and useful effect.

The discharge of water was determined as follows: A distance of 30 feet was measured in the length of the discharging canal, for which distance its width was the same, = 151 inches. At distances of 10 feet, four measurements of depth of current were taken, (making twelve in all,) and their depth averaged, giving a mean depth, the product of which and the width represented the mean cross action. The velocity of the current was determined by repeated trials with a light floating body, and the use of a watch beating quarter seconds. Although not strictly accurate, the result obtained was probably as near the truth as it could be determined without the use of a waste-board.

X.



Railway Accidents; their Cause, and Means of Prevention. By Captain MARK HUISH, Assoc. Inst. C. E. Edited by Charles Manby, M. Inst. C. E., Secretary.*

In entering upon the subject of this paper, it is unnecessary to occupy time in demonstrating the fact, that compared with its results, whether as regards the ease and celerity of transit, or the facility of conveying numbers, railway traveling, even in its present state, is incomparably safer than any previously designed system of locomotion.

Contrasting the mere numbers transported from one locality to another, in the present day, by railways, with those conveyed by coaches during their most active period, the ratio of safety is indubitably in favor of the former; while if the difference of speed is imported into the consideration, the value of the immunity from accident, in the case of railways, is considerably enhanced. Even at the present time, when railway traveling has superseded all other modes of inland communication, it is doubtful whether the contingencies attending conveyance by horses in this kingdom, embracing in that category the omnibus traffic, do not annually exceed in amount the casualties on railways, and it has even been asserted, on apparently sufficient data, that the accidents to pedestrians in a given period would still leave railway managers in a position to point with satisfaction to the superiority of their system, on the score of safety.

The attention which has latterly been paid to the statistics of railways, and the periodical publication of the Government returns, direct public attention very pointedly to the aggregate of accident, in a manner which has not been attempted in any other department, and tend to fix a degree of responsibility, and to cast an amount of odium, which have not attached to less prominent and perhaps less useful adaptations of science and discovery. Were the casualties to steamboats as carefully chronicled, and the deaths in mining as elaborately tabulated, or were even the fact of a British vessel being wrecked on each tide throughout the year, as generally known, the public would view more justly the occurrence under the railway system, of those contingencies, which, even under the most perfect management, must ever accompany the arrangements of fallible man; while, however, it is pleaded in behalf of one of the greatest inventions of the nineteenth century, that due regard must be had to comparative results; and while it cannot be denied, that but little consideration has been exhibited, either by the public, or the press, and still less sympathy been shown, during the difficulties under which the railways of Great Britain have struggled into their present position, it is not contended, either that the system has yet attained the degree of perfection and consequent safety of which it is susceptible, or that it has in all cases been administered in the most judicious manner.

Experience is daily adding to the knowledge of the dangers which in an infinite variety of occult forms, necessarily attach to the momentum of high speeds, and this experience is constantly suggesting fresh precautions and means of prevention. To detail as briefly as possible some of the prominent causes of accident, and to explain the measures adopted for securing the safety of the public (the paramount and primary duty of railway management), is the subject of the present paper.

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* Proc. Inst. Civ. Eng., April 27th, 1852.—London Railway Journal, No. 700.

Without further preliminary remark, therefore, the first point of interest is the road, and the contingencies connected with it, embracing the very important subject of the permanent way.

A firm, substantial, and well kept road is undoubtedly the basis of all safety in railway traveling, and with the heavy and increasing traffic now passing over the iron highways of Great Britain, it requires the most incessant vigilance (especially since the speed of the trains has been increased) to maintain the way in the condition which is essential for the safety of the passengers and the economy of the rolling stock. As the intervals between trains become less frequent, as the speed of traveling is accelerated, and as the heavy merchandise traffic, which promises to form, ere long, the most important feature in the receipts of many lines, increases, the repairs become greater, and at the same time more difficult to carry on. It is not intended in these brief remarks, to enter on the very extensive field of "permanent way," especially as it is a subject so familiar to the members of the society, but the experience of the author leads him to the conclusion, that even more attention than has hitherto been given to this fundamental question, must be devoted to it in future, or the theories which have been constructed, and the practice based upon them, will be found to fail. Improvements are continually introduced for the purpose of obtaining a sound continuous road, and there is no doubt that the recognised evils will eventually point out their own remedy. Fishing the rails is now a popular and, as far as partial experience can determine, an efficient mode of strengthening a railway, for the increased traffic it has to bear. Other measures, having the same object in view, are in course of experiment, and stone blocks are generally being rejected in favor of wooden sleepers. Heavier rails, with shorter bearings, are gradually being introduced wherever relaying has become necessary, and engineers are fully sensible that a road constructed to support moderate trains, drawn by light engines at low speeds, is utterly inadequate to endure the crushing effects of monster locomotives at express speeds. The defects of lamination, deflexion, and splitting of the rails are rapidly increasing; whilst transverse fractures (a species of failure almost unknown a few years ago) are now of frequent occurrence; and the difficulty of maintaining the gauge of the line, under the present weights, not only increases, but much of the oscillating motion which is so unpleasant to the traveler, and so destructive to the stock employed, must be attributed to the same cause. Requiring, as railways do, superior rails to bear the increased strain now thrown upon them, it is painful to observe that, instead of keeping pace with the necessities of the case, the rail-makers have allowed their production to deteriorate very greatly; indeed, the utmost caution is now required in the purchase of rails: with every security afforded by name and standing in the trade, the greatest disappointments are daily arising, and the result promises to be very serious, unless instant measures are adopted by the principal makers, to retrieve their characters in this respect. Many of the rails recently supplied have shown symptoms of failure at an unusually early period, and are, in many instances, in a worse condition, after two or three years' wear, than old and much lighter rails which have been subjected to precisely the same duty for twelve to sixteen years. So grave has the aspect of this matter become, and so general has been the complaint, that one railway Company has come to the determination of rolling its own rails, and has given instructions for erecting works for the purpose. Under all the disadvantages, however, to which allusion has been made, it is, after all, remarkable how very few accidents have arisen from a defective state of the road itself. The circumstance of a train running off the line is very rare, and when such an event does occur, it may generally be attributed to some palpable neglect of the platelayers, to some defect in the machinery, or to some obstructions designedly placed on the line. The latter is unhappily a very fertile source of danger, and one against which, where a morbid desire to inflict injury guides the miscreant hand, it is very difficult indeed to guard. It is little known how frequent, how ingenious, and how varied these attempts have become, and although, from the vigilance exercised, and from fortunate and providential causes, the real damage effected has been far less than could have been supposed, it is lamentable to think, that in addition to the ordinary risks of rapid locomotion, it should be necessary to guard continually against so diabolical a mode of wreaking a petty vengeance, or of gratifying a mischievous disposition. Numerous instances might be given which would excite surprise from the cunning design exhibited, and the care apparently exercised in selecting a spot likely to be fraught with the greatest amount of mischief; but the detail would occupy too much space. One only, and that the latest attempt of this kind, may be mentioned:—A few weeks ago, upon a branch line in Lancashire, the points of an important siding were jammed open, and in order to prevent the signal-man from averting the intended accident, the wire of the auxiliary signal was lashed with a piece of string, and was thus prevented from acting. Happily, however, by a fortuitous circumstance, the villany was discovered a few minutes before the passenger train approached. It has been customary, when such attempts have been made, to offer a considerable reward for the discovery of the perpetrators. It is questionable, however, whether setting a patient watch, and establishing a careful inquiry throughout the neighborhood, are not more effectual means of tracing the culprit. Considerable success has certainly attended this course, while there is, it is believed, no instance of a voluntary statement for the purpose of securing the reward. The punishment for this class of offences has recently been made more severe, and although it is not to be expected that they should altogether cease, it is hoped that they may become less frequent.

The alternations of weather in a climate so variable as England, have a material influence on the permanent way, and on any great and sudden change, either to heavy rain, after lengthened drought, or to a rapid thaw, after continued frost, increased watchfulness is necessary on the part of the upholders of the road, and the engine-drivers and guards. It is at such periods that the weak points in a road show themselves; a sudden relaxation of the line seems at once to take place, and unless counteracted by vigilant attention, great danger must result.

The rapid development of general traffic on all the main arterial lines in the kingdom, and the transfer to them of much of the heavy trade which was formerly carried on by canals, have caused a very great extension of siding accommodation, and this, by multiplying the points and crossings in the main line, has *pro tanto* increased the risk attending them. Anything which breaks the continuity of the rails is necessarily an evil, and tends in a certain degree to develop danger; and as these frequent "turns out" cannot be avoided on a line of heavy traffic, the railway manager is compelled to rely on regulations and signals, and to that extent is obliged to incur the additional hazard which attends the employment of officials, from whose neglect, or want of discretion, the most fatal consequences may at any moment arise. On the London and North Western Railway, the increase of siding, during the last few years, amounts to 53 miles. In laying down these sidings, one very fertile source of danger has, however, been considerably reduced. "Facing points" were formerly common and numerous, they are now rarer, and although at the junctions of branches, and in some peculiar positions, they cannot be altogether abolished, no railway manager will rest contented while one of these points is allowed, unnecessarily, to remain upon his line.

In connexion with this subject, allusion may be made to self-acting switches. Useful as this invention has proved, it has been attended with concomitant evils of no trifling magnitude, and many accidents have occurred from a reliance upon them. They require constant vigilance to secure their being kept clean and well oiled, and it is very difficult to insure proper attention being always paid to them. It may indeed be remarked, as a general rule, that so far from machinery being a means of safety (when used for superseding personal inspection and manipulation), it is usually a source of increased danger, and the numerous clever contrivances and complicated arrangements which are so continually submitted to the examination and opinion of railway men, though evidencing the ingenuity and industry of the projectors, are generally valueless as practical means of operation. The greatest simplicity in every thing connected with the road and the signals upon it will provide the nearest approach to security, and in proportion as such simplicity is departed from, it is probable that a practical good will be sacrificed, in endeavoring to attain a theoretic excellence. In concluding this branch of the subject, it may be repeated, that fewer accidents to life and property arise from the road than from any other cause, and were casualties confined to those attributable to "the way," the annals of railway accidents would be scanty in the extreme.

The next question of interest is the "locomotive"—that extraordinary invention, which has already changed and ameliorated the whole surface of society, and which is destined to work still greater revolutions in the social fabric of the world. The increased power and capacity, the more perfect finish of the various working parts of the engine, and the general improvements in form and proportions, which have been gradually introduced, have rendered far less frequent than heretofore, those delays and irregularities which are always attended with inconvenience, if not with danger; yet it would be too much to expect immunity from casualties to so elaborate and so severely tested a machine, and though the parts have been greatly strengthened in every respect, the improvement does not appear to more than meet the greater demands on its powers, in consequence of the increased loads and speeds which are now adopted.

The variety of mishaps to which a locomotive is liable will be seen from the following table, containing the causes of one thousand failures on the London and North Western Railway.

This return spreads over a lengthened period, comprises every description of defect, and is given for the purpose of proportion only.

ANALYSIS *of* 1000 *cases of engine failures and defects, occurring on the London and North Western and subsidiary Railways.*

STOCK OF ENGINES, 587.

157	Burst and leaky tubes.
92	Broken springs.
89	Broken valve-spindles.
77	Broken and defective pumps.
48	Broken feed pipes.
40	Broken piston rods and pistons.
34	Broken and damaged valves and valvular apparatus.
34	Lost and broken bolts and pins, (various.)
34	Fire bars burnt out.
31	Lost and broken cotters, (various.)
29	Plugs and joints blown out.
25	Broken and lost eccentric straps.
21	Broken wheels and tyres.
21	Broken and bent coupling and connecting rods.
17	Broken sponge boxes.
17	Broken and bent eccentric rods.
17	Broken crank pipes.
15	Broken and shifted eccentric shafts.
15	Broken coupling and draw bars.
13	Broken crank and other axles.
13	Broken eccentric straps and bolts.
13	Broken and damaged steam and suction pipes.
13	Broken and defective reversing levers.
11	Broken connecting rod straps.
11	Broken middle bearings.
9	Broken spring bearings, screws and buckles.
8	Broken lifting links.
904	Carried forward.
904	Brought forward.
7	Broken blow-off and other cocks.
6	Broken quadrant studs.
6	Lost and loose regulator spindles.
6	Broken gibs.
5	Broken stay in fire boxes.
5	Detached ash-pans.
3	Smoke box and chimney end on fire.
3	Broken brackets of weigh bar shafts.
3	Feed pipes stopped up, dropped fire.
3	Broken spring balances.
3	Broken slide blocks.
3	Broken crank rods.
3	Tubes drawn in (Chimney end.)
3	Broken axle boxes.
3	Broken slide valves.
3	Broken right hand bearings.
3	Broken glands.
3	Defective hose pipes.
3	Broken piston rings.
2	Broken brakes.
2	Lost quadrant washers.
2	Broken goss head spindles.
2	Mud-hole doors defective.
2	Broken weigh bars shafts.
2	Broken brasses of driving journals.
2	Broken studs of link motion.
2	Broken catches of fire bars.
2	Broken glass tubes.
1	Nut off tender draw-bar.
1	Broken tender eye bolt.
1	Defective whistle.
1	Boiler burst.
1000	Gross total.

It would be interesting to know how far this return coincides with the results on other railways, because, were somewhat similar ratios evolved, the knowledge of the proportions would direct the special attention of locomotive superintendents to the necessity of guarding more particularly against casualties of most frequent occurrence. It will be observed that burst and leaky tubes nearly double any other class of failure, and that these with broken springs and broken valves amount to one-third of the entire number. Very few, indeed, of the above failures are attended with any direct danger to the public, but as producing a temporary, or permanent inability of the engine to carry on its train, may be the remote cause of collision.

The carriage stock of railway Companies is generally of so superior a kind, both as to design and construction, that accidents arising from their failure are very rare. The wheels and axle-boxes are the most severely tested parts of the vehicle, but if originally of a proper construction, give very little trouble in their maintenance and repair. Experience seems to give the superiority to the wooden wheels, of which there are many kinds in use. A spring sometimes breaks, and a tyre occasionally fails, in which case the wheel is in danger of flying to pieces, but the instances are so unfrequent, that they are not sources of much anxiety to a railway manager. Defective workmanship, where either the carriage, or the principal parts of it, are supplied by contract, has specially to be guarded against; where these are sound and the carriage is daily examined, it may be relied on for a very long period. During the last four years, only six wheels have failed, in the very large stock of the London and North Western Company. The heating of axles, however, is a source of frequent annoyance and alarm to passengers. Since the bearings were increased in size, and more care has been exercised to make the cover fit close, and to preserve the grease free from dust, when not in use, this cause of trouble has diminished, and the recent introduction of the patent axle-box, which, under proper management, will run many hundreds of miles without being fed, bids fair to obviate the evil to a considerable extent, if not to prevent it altogether; still, on a hot summer's day, in a district with sandy ballast, it is, and will always be, very difficult to keep the axles of a fast train cool. The couplings of carriages are seldom broken, even by sudden jerks.

There is, perhaps, no more alarming occurrence than a fire in a passenger train. Still, however, there has not been an instance in this country of any loss of life from this cause, nor have the cases been numerous; but there have been several narrow escapes, and the accident is one to which a train may be at any instant subject from the escape of heated coke. Spontaneous combustion has also in more than one instance nearly produced a serious conflagration. This has arisen from the incautious introduction of lucifer matches, or similar combustibles, among the luggage of the passengers. The occurrence of fire, and the feeling of nsecurity which attaches to the passenger, from a feeling of inability to stop the train, if desired, from any other cause, is continually reproducing a multitude of schemes for communicating between the passenger and the guard, and the guard and the driver. These have assumed a multiplicity of forms, yet the principle is generally identical, viz: a connexion by wire, or rope, between the engine and the guard's van. Simple and inexpensive as this contrivance is, it fails in practice, and after being adopted more than once, has again been laid aside. The whole of the trains of a northern Company were some time back fitted with the means, by a flexible jointed tube, of communicating with the driver, but it has not been considered a successful attempt to overcome the difficulty. The same may be said of the numerous contrivances for arresting the passage of a train, by the instantaneous application of a number of powerful brakes, (some of the inventions applying the brake to the road itself;) of the proposals to work signals by means of the engine striking certain levers as it passes; and hundreds of similar suggestions. Among the inventions transmitted to the author, and for most of which compensation was claimed, one proposed to arrange a set of signals, which were to be successively struck down by the chimney of the engine; and another, in order to stop a train in the shortest space, gravely proposed that a large anchor attached to a stout cable, should be thrown out of the stern! Perhaps the most feasible and favorite plan for giving confidence to passengers, has been to continue the foot-boards of carriages, so as to form a continuous narrow platform, with a brass rod attached to the panel of the carriages; by this means a passenger might escape and pass safely along to the guard's van, or to the engine. The plan was suggested to and recommended by the Railway Commissioners. A committee, of the most experienced railway officers, was appointed by the clearing-house to consider it; they have done so, and their report, founded on returns and reasonings, which appear unanswerable, is the unanimous condemnation of the measure. We are thus apparently as far off as ever from gratifying the public demand for instant communication between the passenger and the guard, and it is possible that no better plan will be discovered, than that now in use on the London and North Western line. It is as follows:—The guard's van at the rear of the train, projects more than a foot beyond the carriage on either side. In this projection a glass window is fitted, the guard's covered seat being opposite to it. He is thus enabled to see the entire length of the train, and can scarcely fail to observe a hand, or a handkerchief, if waved from a window. This contrivance is evidently unavailing at night, unless a spare light were by some means placed at the disposal of the passenger. At present, however, it only to some extent meets an evil, for which no more practical and complete cure has yet been provided. The almost universal practice of leaving the doors at one side unlocked, is a source of not unfrequent accident; yet so distasteful in public opinion is a locked door, that only one Company has ventured to adopt it as a rule. The reckless conduct of many habitual travelers may yet possibly force it as a regulation on others, especially if juries continue to inflict severe punishment on Companies, even when the fault is primarily with the passenger himself.

If, however, there is no part of the railway machinery from which so little danger may be apprehended as the passenger carriage, the same cannot be claimed on the part of the merchandise wagon. Whether the absence of direct danger to human life, or an injudicious economy, has been the cause, the fact is, that in no portion of the system has so little improvement been exhibited, and in which, at the present moment, there is so great a necessity for a complete modification. In this respect England is far behind the Continent. The axles of wagon stock have, in many instances, been of the most faulty model and material. The accidents to the trains, from the fracture of these parts, have been very numerous, while the destruction of property has been sufficient to have paid for a very superior vehicle. In one recent instance, several hundred axles, of a peculiar form, were removed from a leading railway, after a short experience of their working. Axles are now made much stronger than formerly; 3½ inches used to be the ordinary diameter, 4 inches is now considered a minimum, and although more attention has been bestowed on the form and taper of the axle itself, still very much remains to be done in this matter. The fact of the crystallization of the iron by the repeated vibrations, and the peculiar causes of incipient fractures, are still debatable points with engineers and wagon builders. It is desirable that by a thorough examination of the subject, these disputed questions should be disposed of. The wrought iron wheels of merchandise wagons do not on the whole give much trouble. The most defective part of the wagon is, however, the mode of coupling. This is of the rudest kind, and it is matter of surprise that a vigorous and combined effort has not been made by the railway interest to improve it. Very few merchandise wagons have spring buffers, and even those that have them, are simply linked together by a loose chain. Every one must have noticed the bumping sound produced in the starting and stopping of a merchandise train. Even where the driver is very careful, the succession of heavy blows in a long train is sufficient to injure the stock, and to break any delicate articles that may be conveyed in the trucks; but when it becomes necessary to arrest a train suddenly, the shocks are very destructive to the framework. This evil, great as it is, is aggravated by the circumstance of a variety of wagons being run in the same train; a light and short wagon is probably found between two long and heavy ones, and the irregularity of loading, according to the staple trade of a particular district, still further increases the risk. From the through system of traffic, the wagons of half a dozen Companies may frequently be found in one train, and as these are not built to any particular height or breadth, the ends do not strike evenly, and on receiving a check, a tendency to mount (especially if the wagon is unevenly loaded, which must always be the case with some description of goods) is apparent. Covered vans, low timber trucks, and box-wagons, are all run together, in trains of from 30 to 60 vehicles, and at speeds varying from 15 miles to 20 miles an hour. It is, in fact, a wonder that a traffic so conducted is not subject to continual accident, and the circumstance of the comparative freedom from casualty is rather an evidence of the extreme safety of transit over parallel iron bars, than any defence of a system which is no credit to the mechanical skill of the country. Until every wagon is coupled up to spring buffers, in the same manner as a passenger carriage, and until either by general concert, or by compulsory regulation, the standard central height, and central breadth between the buffers, are matter of regulation, the risk of accident and the certainty of damage must continue. The author succeeded, some years ago, in obtaining, through the medium of the railway board, a general concurrence on the subject of the buffers of passenger carriages, but no measures have yet been effectual as regards merchandise vehicles.

Fires in merchandise trains are of frequent occurrence, and from the susceptibility of the tarpaulin covering to ignite, and the presence of straw in the loading, considerable danger must always exist. This fact and the damage which fine goods receive from wet, have caused the introduction of covered wagons. The use of these wagons is now greatly increasing, and for all goods capable of being closely packed, they bid fair to entirely supersede the open truck and tarpaulin. The first cost is greater, but the repairs of the sheets, in three or four years, will fully compensate for the difference.

(To be Continued.)

AMERICAN PATENTS.

List of American Patents which issued from Dec. 14th to Jan. 4th, 1852, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

DECEMBER 14th.

24. For an *Improvement in Lining for Iron Safes, &c.;* Wm. P. Blake, City of New York.

"My invention consists in applying the protoxide of zinc, in its finely divided amorphous condition, as a filling or "packing" around or within the walls of iron safes, refrigerators, steam pipes, steam chambers, locomotive boilers, hot-air flues, and chambers."

Claim.—"What I claim as my invention is, the application of amorphous zinc oxide as a lining for safes and refrigerators, and as a covering for steam pipes, steam chambers, locomotive boilers, hot-air flues and chambers, in such manner as to prevent the transmission or conduction of caloric into or from such chambers or flues."

25. For an *Improvement in Trip Hammers;* Jas. C. Forrest and Geo. Baker, Schenectady, New York.

Claim.—"What we claim as our invention is, the employment of the peculiar shaped movable tappets of different sizes—the said tappets being arranged loosely on the driving shaft, and moved back and forth—or one substituted for the other by means of the lever, in combination with the hammer, having a rectangular, notched or peculiarly formed slot cut in it, the whole being constructed, arranged, and operated in the manner and for the purpose herein described.

"We likewise claim so arranging the lever that when the large or small "tappets" are moved from one position to the other, or the small tappet made to occupy the place of the large one, the controlling spring will also be operated upon and made to assume a proper position to suit the size of the "tappet"—the arrangement for effecting this object consisting of a hook-shaped shifter and movable collar, which are constructed, arranged, and operated in the manner substantially as herein set forth."

26. For an *Improvement in Field Rollers for cutting Stalks and Weeds;* Joseph H. Gest, of Batavia, Ohio.

"The nature of my invention consists in the employment or use of a series of knives, either of straight or spiral form—said knives being placed upon a suitable roller, and the roller placed within a proper frame, and attaching to the front part of the frame pins, which will be hereafter described—the pins being for the purpose of bringing the stalks within the range of the knives; forks attached to the tongue also effect the same purpose."

Claim.—"Having described the nature and operation of my invention, what I claim as new is, the employment or use of the knife-roller—said knives being either of straight or spiral form, in combination with the pins and fork; the knives, as the machine moves along, cutting the stalks from the roots, and also the stalks into pieces while lying upon the ground, and the pins and prongs of the fork drawing the stalks within range of the knives, as herein specified."

27. For an *Improvement in the Manufacture of Ball Castors;* Robert Hinton, Roxbury, Massachusetts.

Claim.—"I claim the improvement in making the case of the ball castor, viz: of a combination of two halves or parts, the curved lip and the ring, as constructed and applied together, and to the leg or socket ferrule thereof, substantially in manner and for the purpose as above set forth."

28. For an *Improvement in Stone Picks;* John U. Houston, Conway, Massachusetts.

"The nature of my invention consists in providing the inner side of the hammer of the pick with a guard, which guard will intercept the chips of stone, and protect the hand."

Claim.—"What I claim as my invention is, the addition of a guard to the inner side of the hammer of mill-stone picks, which guard will intercept the chips of stone, and protect the hand and person of the picker, using for that purpose the metallic guard above described, or any other substantially the same, and which will accomplish the same result. I do not claim as my invention, the mode of constructing the pick as described, in other respects than as pertains to the guard."

29. For an *Improvement in Buckets for Endless Chain Pumps;* Clark Polley, Mays Landing, New Jersey.

Claim.—"What I claim as my invention is, the globular elastic and adjustable bucket for chain pumps, constructed substantially in the manner and for the purpose herein set forth."

30. For an *Improvement in Apparatus for Treatment of Fractures;* Zimri Hussey, Chilicothe, Ohio.

"This invention consists in certain improvements in and certain appendages to be applied to the apparatus known as the double inclined plane, for the purpose of making a more perfect instrument, which I term the Perfect Adjuster.

"It also consists in the attachment of a seat-piece, with certain braces and other appendages, to a pair of double inclined planes or perfect adjusters, for the purpose of rendering additional aid in the adjustment or reduction of the most difficult cases of fracture or luxation of the lower limbs, where both or only one are injured."

Claim.—"Having described my invention, what I claim are, 1st, The hip-brace of semi-circular, or nearly semi-circular form, and the strap passing over it and around the limb, the said strap and brace operating as and for the purpose substantially as set forth. 2d, The knee fork attached either to the upper part or lower part of the double inclined plane, for the purpose of attaching a band, which clasps the limb, to effect extension or counter-extension at the knee, as herein explained. 3d, The application of the adjustable braces to the crests of the ilium, substantially as and for the purpose described, the said braces being attached to a seat-piece or its equivalent. 4th, The seat in combination with an adjustable back-piece attached to two double inclined planes, substantially as herein described, for the purpose of moving the cripple without changing the adjustment of the splints, for the purpose set forth."

31. For an *Improvement in Seed Planters;* Henry Nycum, Uniontown, Pa.

Claim.—"What I claim as my improvements are, 1st, The construction of the compound grain slide as described, by which the amount of grain required to be sown, is graduated at pleasure, as herein fully set forth. 2d, The *mitre bar*, constructed so as described, to *raise* the apparatus for lifting the drill teeth and throwing the slides out of gear completely out of the way of the operator, thus allowing him to get at the drill teeth, for the purpose of clearing them of obstructions, with a facility altogether unknown in machines constructed with a horizontal bar in the rear."

32. For an *Improvement in Scythe Snaths;* Abram Charles and Charles N. Clow, Port Byron, New York.

"The nature of our invention consists, first, in constructing the snath of metal in the tubular form, for the purpose of securing great durability, and facility of shaping it as desired, while it retains the required lightness and strength; and secondly, in the manner of adjusting the nebs on the snath, as hereinafter fully set forth."

Claim.—"What we claim as our invention as a new manufacture is, a scythe or cradle snath, composed of a wrought metal tube, which possesses the advantages of great durability and facility of being bent into any desired form, without increasing its ordinary weight, or impairing its usual strength and firmness.

"We also claim the longitudinal rib, or its equivalent, on the snath, in combination with a series of notches in the ring of the neb, for the purpose of adjusting the nebs securely upon the snath, substantially as herein set forth."

33. For an *Improvement in Straw Cutters;* Joel Dawson, Barnesville, Ohio.

Claim.—"What I claim as my invention is, in combination with the rake and spring, the pressure piece and the roller, constructed and arranged in the manner and for the purpose as hereinbefore set forth."

34. For *Improvements in Machinery for Forging Metals, &c.;* Wm. Field, Providence, Rhode Island; ante-dated June 14, 1852.

"My invention and improvement consists in forging a piece of properly heated metal into shape, by subjecting it to the action of a pair of traversing rollers, which run against pattern guides, the counterpart in shape of the longitudinal outline of the thing to be forged, the metal itself being supported between the rollers by a mandrel and turned on its axis, to present different sides of the piece in succession to the action of the rollers whenever this is required."

Claim.—"Having described my machine for forging metals, what I claim therein specifically, is, First, The mandrel, or its equivalent, for chucking or griping the metal to be forged, and holding the same in the proper position, and, from time to time, changing its position between the reciprocating rollers, in combination with reciprocating rollers for shaping the metal so held, whose action upon the metal is regulated by a pattern guide, substantially as herein set forth. Second, The method of regulating the thickness and shape of the metal being forged, without stopping the rollers or withdrawing the metal therefrom, by the simultaneous adjustment of the pattern guides, substantially as herein described."

35. For an *Improvement in Apporatus for the Cure of Club Feet;* Zimri Hussey, Chilicothe, Ohio.

Claim.—"Having described the nature, construction, and operation of my invention, what I claim is, the side pieces, to which are attached the adjustable foot pieces, connected and adjustable to each other, in the manner substantially as described, by the back piece, plates, bolts, and slots.

36. For an *Improvement in Plough Regulators;* Harvey Sprague, Riga, New York.

Claim.—"What I claim as my invention is, the combination of the arms with the connecting and regulating bar, the arms and the connecting bar forming an arch, and working on an axle which passes through the beam, in the manner and for the purpose substantially as herein described and set forth."

37. For an *Improvement in Spike Machines;* Philip P. Traysor, Baltimore, Maryland.

Claim.—"I wish it to be understood that I do not confine myself to any particular form or arrangement of the several parts of the machine I have just described, provided the spike is headed and pointed by the mode of operation I have described; as a great number of changes may be introduced into the machine, that will not in any way affect the principle upon which it works; indeed, the improvements which I have made could be introduced with advantage, either separately or together, into various machines now in use.

"What I claim as my invention is, the combination of the hinged pointing die, pressed forward by a spring with the guard or stop, or the equivalent thereof, which guides the die and limits its forward movement, substantially as herein set forth."

38. For an *Improvement in Seed Planters;* Moses D. Wells, Morgantown, Virginia.

Claim.—"Having explained my improvement, what I claim as new, and as my own invention, is, the reciprocating bar, having wings projecting horizontally on the front and rear sides of the same, to scoop the seeds in the discharge apertures—arranged and operating in the manner and for the purpose above specified."

39. For an *Improvement in Grain and Grass Harvesters;* William H. Seymour, Assignor to W. H. Seymour and Daton S. Morgan, Brockport, New York; ante-dated October 25, 1852.

Claim.—"Having described my improved harvesting machine, what I claim as my invention is, the method herein described, of supporting the stand for the raker at the back of the platform, by means of a brace extending to the outer end of the frame, and so arranged as not to impede the action of the raker, or the discharge of the cut grain, the several parts being constructed and arranged as described.

"I also claim the method herein described, of protecting the gearing of the machine from injury by the working and twisting of the main frame, by mounting the said gearing in a supplementary metallic frame, constructed as described, and rigidly connected to one end of the main frame upon which it is mounted, as herein set forth."

40. *For Mechanism for Pointing and Threading Screw Blanks in the same Machine;* Culley Whipple, Assignor to the New England Screw Company, Providence, Rhode Island; ante-dated October 16, 1852.

Claim.—"I desire it to be understood that I do not here claim the broad idea of pointing and chasing the blank in the same machine by different cutters, irrespective of the mechanism employed for the purpose, as I have made such a claim in another specification, on which I have made application for letters patent. My claim in this specification, on this head, is restricted to the mechanism I have described.

"What I claim as my invention is, the arrangement of the pointing and chasing tools on the same tool-holder, in such manner that they are operated by a common motion, substantially as herein set forth."

41. For an *Improvement in Machines for Cutting Whale Blubber;* Lydoriann Ricketson, (Administratrix of Henry H. Ricketson, dec'd,) New Bedford, Massachusetts.

Claim.—"I am aware that in machines for cutting straw, or such like matters, a cutting cylinder has been made to operate on a bed roller, and that the knives on the said cutting cylinder have been arranged in a helix upon it. It is not claimed that such constitutes in any respect the invention of the said Ricketson, deceased.

"But what is claimed is, the wheel, composed of two or more spiral knives, made to rotate on an axis arranged parallel and in the direction of movement of the strip of blubber to be cut, all substantially as above set forth, meaning to claim two or more spiral knives, formed, arranged, and made to operate with respect to and in combination with a set of bed and feed rollers, substantially in the manner and for the purpose of cutting blubber, substantially as above described."

DECEMBER 21st.

42. For an *Improvement in Rakes to Grain Harvesters;* Jearum Atkins, Chelsea, Ill.

"The nature of my invention consists in so hanging and operating the rake as that it travels across the platform at a right angle to the draft, for collecting and compressing the grain against a palm, or hand, which, together with the rake, clutches the gavel so formed, and swinging partly round, delivers it in rear of the machine."

Claim.—"Having described my invention, I desire to state that I do not confine myself to the exact mechanical devices and arrangements shown and described, for operating the rake, as these may be modified, or others substituted for them. What I claim is, the exclusive use of the herein described combination of the crane-post, rock-shaft and crank. to operate the jointed arm and hands, which collect the grain in gavels and deposit it in rear of the harvester in the manner specified, as the machine moves forward, when applied to machines for harvesting any grain which requires to be so collected and deposited, the combination being connected by gearing with the driving wheel of the harvester, and operating through mechanical devices, substantially as described, as an automaton, to perform the above specified operations."

43. For an *Improvement in Water Closets;* Wm. S. Carr, City of New York.

Claim.—"I am aware that a hopper closet has been made, in which the weight of the person caused a cock, something similar to that herein shown, to let the water into the hopper-shaped pan, and I am also aware that closets have been made, in which the pan was moved away by the motion of the seat, and the water made to run; but I am not aware of any previous arrangement, in which an air tight reservoir has been used, the filling or partial filling being effected by motion of the seat letting on the water, and when the weight is removed from the seat, the supply of the water is shut off, and a connexion opened between the air vessel or reservoir, and the pan or basin of the closet.

"Neither am I aware of any arrangement of the parts by which the pressure of water opens the pan, thereby avoiding a separate and distinct operation by hand, always subject to neglect or hasty and improper performance, by which the water has not time to act. I do not claim any of the parts of the pan, basin, or hopper, as these may be of any desired character, and if used with the hopper closet, without a pan, the parts which move the pan may be dispensed with.

"What I desire to secure by letters patent is, the cylinder and plunger, by which the force of the water is made to raise the lever, depressing and emptying the pan, as described and shown."

44. For an *Improvement in Ventilators;* A. S. Dozier, Norfolk, Virginia.

Claim.—"Having described my improved ventilator, and the method of operating the same, I wish it to be understood that I do not claim a ventilator with slats or shutters fixed in the sides of a cupola or dome, or other structure, placed on the top of the building, or elsewhere; but what I do claim as my invention is, the arrangement of the frame in the sides of the cupola or dome, projecting slightly beyond the face thereof, to admit the lips or turned ends of the slats or shutters, to lap over the same, in order to form tight joints, and the manner of hinging or jointing the slats or shutters to the same by the joint pins.

"I likewise claim the radial wings when combined with the frame of the dome or cupola, for directing the currents of air to the spaces between the slats or shutters, as described, and thence to the trunk."

45. For an *Improvement in Straw Cutters;* Warren Gale, Louisville, Kentucky.

Claim.—"What I claim as my invention is, constructing the rotating cutting cylinder, substantially as described, with a series of parallel annular grooves and ridges, and a series of cutting arms, or knives, in combination with a series of fixed knives, so arranged that they enter the grooves and interlock or lap past the annular ridges on the cylinder, and thereby prevent the stalks of straw, &c., from descending between the fixed knives and cylinder without being cut, substantially as herein set forth."

46. For an *Improvement in Ploughs;* Wm. A. Gates, Mount Comfort, Tennessee.

Claim.—"Having described my improvement in the cotton scraper, what I claim as my invention is, the rhomboidal plate, bent on one of its diagonals, and constructed and arranged substantially as described, so that either leaf can be used as a landside, or share, at pleasure; the edges of the share becoming, when the plate is reversed, the edges of the landside, and those of the landside the edges of the share, in the manner and for the purposes specified.

"I also claim, in combination with the plate as described, the double bifurcated brace for attaching said plate to the beam, substantially as described."

47. For *Improvements in Machinery for Manufacturing Hat Bodies;* Lansing E. Hopkins, City of New York.

Claim.—"I do not claim the conical vibrating rollers for the purpose of felting or compressing a bat or the cone separately, as that is well known. But I claim combining the hardening rollers with the perforated cone, by means of a yielding or hinged frame, in which they are placed, substantially in the manner and for the purpose herein described.

"I also claim giving to said rollers, in combination with said perforated cone, a vibrating endwise motion, as well as a rotary motion, substantially as described and for the purpose set forth.

"I also claim blowing the exhaust air from the former into the chamber, for the purpose and in the manner described.

"And I also claim the mode of forming the steam pipe outlet as above specified, by covering the steam-pipe with cloth, and in casing it with an outer metal case.

"I also claim covering the perforated cone, preparatory to a deposition of fur thereon, with a covering of thin cloth, easily pervious to air, upon which the fur is to be deposited; said cloth or fabric to be removed at each operation, with the hat body deposited thereon."

48. For an *Improvement in Grain Threshers and Cleaners;* John Jones and Alexander Lyle, Rochester, New York.

Claim.—"Having described the construction and operation of our machine, what we claim as our invention is, the combination of the upright threshing and separating cylinders, with the upright concave and cylindrical sieves, operating in the manner and for the purpose as herein set forth."

49. For an *Improved Equalizing Apparatus for Engines which use Steam Expansively;* Wm. H. Morrison, Indianapolis, Indiana.

Claim.—"Having described the nature of my method of equalizing the action of steam, I claim therein as new and of my invention, the application to a reciprocating engine (in which the steam is used expansively) of the described or equivalent toggle movement, in combination with a pair of equalizing cylinders, which, being placed at a greater or less distance, (one on each side of the mid range of the toggle,) the most rapid accumulation of equalizing force is made to take place earlier or later in the stroke, in accordance with the period of cut-off, &c., for the purposes herein described."

50. For an *Improvement in Maize Harvesters;* Jacob L. Ream, Mount Pulaski, Ill.

Claim.—"Having described my improvement, what I claim as my invention is, the arrangement of the shaft of the receiving arms with one end resting upon the cutter barpiece, thereby dispensing with an intermediate platform, so that the cut stalks will fall directly upon the receiving arms, and be thence discharged in bundles upon the ground, as set forth."

51. For *Cut-off Valve Motion;* S. W. Rogers, Baltimore, Maryland.

"The nature of my invention consists in a particular arrangement for operating the cut-off valve."

Claim.—"Having fully described my invention, I do not claim placing the cut-off valve outside of the slide valve, and operating both valves by one rod or eccentric. But I do claim the lugs acting upon the hinged levers, attached at their lower extremities to the cut-off slide, and at their upper to a rod capable of a vibratory movement, in a direction perpendicular to the valve seat, substantially for the purpose and in the manner set forth."

52. For an *Improvement in Potato Diggers;* Jesse N. Seeley, Forsyth, Georgia.

Claim.—"Having fully described my invention, what I claim is, the construction of a potato digger by the combined arrangement of the knife, wheel, and fork, with the beam, operating substantially as in the manner set forth."

53. For an *Improvement in Lamps for Locomotive Engines;* Thomas and Stephen Hill, Rochester, New York.

Claim.—"What we claim as our invention is, 1st, the construction of a feeder for supplying oil to the holder, by the combination of two tubes, one communicating with the interior of the reservoir, and the other fastened to a float immersed in the oil of the holder, by which the lamp is rendered self-feeding, in the manner and for the purposes herein specified.

"2d, The construction of the chimney with a broad flat flue connecting its vertical portions, the exterior one of which is so constructed as to be forward, or on either side of the prolongation of the chimney of the burner, substantially in the manner and for the purposes herein specified."

54. For an *Improvement in the Manufacture of Chromate of Soda;* John Swindells, Manchester, England; patented in England, November 14, 1850.

"My invention consists in the process for the production and manufacture of the chro mate of soda, for the purposes of bleaching, printing, dyeing, and color-making."

Claim.—"Having now described the nature of my said invention, and the manner in which the same is to be performed, I hereby declare that I claim as my invention, the process described for manufacturing the chromate of soda-dyeing."

55. For an *Improvement in Falling Mills;* Wm. E. Underwood, Middlefield, Mass.

"The nature of my invention consists in providing an attachment to the rotary fulling mill, which will, in case of the entanglement or knotting of the endless chain of cloth, causing one of the compressing rollers to slip on the cloth, that the driving belt will be thrown off, thereby stopping the machine and preventing the cloth from being damaged by the compressing rollers."

Claim.—"What I claim is, the combination of the stop mechanism, or its equivalent, with the screw pulley and the elastic band leading to the pulley on the upper roller, whereby the whole machine is stopped when the motion of the cloth is arrested in the manner described, and ceases to impart motion to the upper roller."

56. For *Machinery for separating Iron from Furnace Cinders;* Danl. Walroth, Chittenango, and Lucius Evans, Manlius, New York.

Claim.—"What we claim is, the combination of the revolving, breaking, and sifting cylinder with the fan, or its equivalent, substantially in the manner and for the purposes specified."

57. For an *Improvement in Steam Flat Irons;* Caleb C. Walworth, Boston, Mass.

Claim.—"Having explained my invention, I would have it understood that I claim the steam ball and socket smoothing iron, as made of a combination of a spherical socketed smoothing block, and a hollow or chambered sphere, with induction and eduction passages arranged so as to admit steam and discharge condensed water, all substantially as hereinbefore set forth, the block being applied to the sphere in such manner that it may be moved thereon in various directions transversely, while passing over and against a hat or surface to be smoothed, as specified."

58. For an *Improvement in Planing Machines;* Arctus A. Wilder, Detroit, Michigan; ante-dated July 17, 1852.

"The nature of my improvements consist in constructing planing machines so that the board to be planed can be clamped to the reciprocating bed, whilst being fed by the backward motion of the planes, so that the board will be free to move over the stationary bed plate upon which it is planed."

Claim.—"Having described my invention and improvement in machines for planing, tonguing, and grooving boards, I disclaim the invention of planing by a reciprocating plane, which planes on its forward stroke and feeds the board on its backward stroke, as in other machines of this class. But what I do claim in planing machines of this character is, clamping the boards when being fed by the backward motion of the planes to the reciprocating bed only, so that it will be free to move over the stationary bed plate, upon which it is planed, substantially in the manner and for the purpose described."

59. For an *Improvement in the Method of Measuring Cloth on the Cloth Beam;* Wm. H. Woodworth, Salmon Falls, New Hampshire.

Claim.—"What I claim as my invention is, connecting or attaching a measuring cord (constructed as described) to the cloth, so as to be wound on the cloth beam with it, in order to indicate the length of the 'cut' desired."

60. For an *Improved Safety Lock;* Linus Yale, Jr., Newport, New York.

Claim.—"First, I claim, in combination with the tumblers, or their equivalents, constructed and connected, respectively, to stop, in the manner, or in an equivalent manner, to that described in the specification and shown in the drawings, the spring, the same being an additional device, co-operating with the said tumblers and springs connected therewith, in rendering the movements and positions of the stops to the highest degree uncertain, when an attempt is made to unlock the lock, without using the proper key.

"Secondly, I claim the wheel and the lever, in combination with the tumblers, constructed as before described, or their equivalents, to raise, while in one position, and support the tumblers, that the key-hole shall be equal and smooth, to receive the key, and then allow them to be stopped at proper heights on the key, while a revolution is performed, and the bolt moved by the wheel, substantially as described."

DECEMBER 28TH.

61. For *Improved Parrel for Yards of Vessels;* Danl. S. Bayles, Brooklyn, N. Y.

"The nature of my invention consists in combining and arranging a rocker in front and rear of the mast, capable of motion in two planes, with rockers at the sides, to which the pearl-rope leading to the aft rocker is connected, by which the motion of the yard will be rendered free and easy, and not liable to injure the mast in cock-billing the yard, and jam in the jaws of the yoke whilst being lowered, as in the old mode of construction."

Claim.—"I do not claim the rocker simply and by itself as my invention, a saddle or slide having been heretofore used and fastened into the swallow-tail of the gaft and boom of sailing vessels, applicable to fore and aft sails only. But what I do claim as my invention is, the combination of the rocker in front of the mast, and capable of a motion in two planes with the rockers at the side of the same; said rockers being arranged with respect to each other and the yoke, substantially as described."

62. For *Improvements in the Method of obtaining Gold, &c., by Amalgamation;* M. A. Bertolet, L. Kirk, and A. M. De Hart, Reading, Pennsylvania.

Claim.—"Having described our improved method of separating precious metals from their ores by amalgamation, what we claim as new therein is, bringing of the ore, in a heated state, into contact with mercury during the process, substantially as herein set forth.

"We also claim the method of heating pulverized ore by causing it to pass in a shower through a current of some heated fluid, preparatory to bringing it into contact with the mercury, substantially as herein set forth.

"We also claim the method of heating the apparatus, the mercury, and the ore, by means of a current of heated fluid, circulated through chambers and pipes, substantially as described, whereby a single current of a suitably heated fluid, and a single system of circulating pipes of simple construction and compact arrangement, are made to heat the whole of the apparatus that requires to be heated, and to heat the ore in the process of feeding and the mercury in the process of amalgamating, substantially as specified."

63. For an *Improvement in Winnowing Machines;* Samuel Canby, Ellicott's Mills, Maryland.

Claim.—"Having fully described my improvements in grain winnowers, what I claim as my invention is, the combination of the piston, rack rod, pinion, valves, and eccentric pulley, in connexion with a conducting chest and blower, for the automatic gradnation or government of the blast through the spouts of a winnowing machine, arranged and operating in the manner and for the purpose set forth."

64. For an *Improvement in the Process of Making Illuminating Gas;* George Danre, Pascal Nicolas, and Felix Lopez, Marseilles, France.

Claim.—"What we claim as our invention is, the combination of woody and fatty substances in gas generators, as described, so that the excess of hydrogen in the former may combine with the excess of carbon in the latter, and produce a rich carburetted gas of any required density, and free from sulphurous fumes."

65. For an *Improvement in Temples for Looms;* Elihu and Warren W. Dutcher, North Bennington, Vermont.

"Our invention consists in arranging a reciprocating "roller temple," so as to accommodate itself to the back and forth or yielding motion of the cloth, as produced by the beat of the lay, whereby the temples may be set up closer than usual to the reeds, without danger of the latter being damaged by striking the former."

Claim.—"Having described our improved weavers' temple, what we claim as new therein is, 1st, The arrangement of parts, so that the temples have a reciprocating action corresponding with the motion given to the cloth by the beat of the lay, substantially as herein set forth."

66. For an *Improvement in Cutting Paper;* John P. Farnum, Assignor to himself, Jacob Jenkins and Charles B. Clark, Andover, Massachusetts.

Claim.—"Having described the elements of the combination invented by me, and explained the mechanism I have adopted for putting them in action in the manner as hereinbefore specified, I do not intend to confine my invention to the precise form or arrangement of its parts as represented in the drawings; but intend to vary the same to any extent, while I do not change the character of the machine.

"What I claim is, the combination of a press, or its equivalent, for holding the book or paper to be cut, with one or more cutters or knives, for trimming the front or one edge, and one or more cutters for trimming one or both of the other edges of the book, the different sets of cutters being simultaneously operated, while the paper or press is moved towards them, all substantially as above specified.

"And in combination with such cutters or knives for trimming one, or the front and other edges of a book, at one operation or time, I claim the improvement of combining with them, or either of them, one or more polishing surfaces as described, or their equivalents, whereby the edges of the sheets of paper are cut and polished or smoothed, ready for gilding, substantially as specified."

67. For an *Improved Mode of Mounting the Cutters of Machines for Planing Metals, &c.;* Pierre Saulnier, Assignor to John T. Bruen, City of New York.

Claim.—"I wish it to be understood that I do not limit myself to the special mode of construction herein specified, as this may be changed at pleasure, so long as the principle or character of my invention is retained.

"What I claim as my invention is, hanging the cutters to the stock by means of a joint pin, or its equivalent, whose axis is diagonal to the line of cutting motion, and in a plane parallel with the surface, being cut, substantially as specified, for the purpose of relieving the cutting edge in two directions as specified, when the cutter-stock is set perpendicular to the plane of the surface to be produced.

"And I also claim combining together in one cutter-stock two cutters, hung substantially as specified, and with the angle of the axis of the two joint-pins reversed as specified, for the purpose of relieving both cutters from the two surfaces, when cutting in both directions, as specified."

68. For an *Improvement in Magnetic Printing Telegraph;* Royal E. House, City of New York.

"The nature of my invention and improvement consists in certain machinery for composing and printing, at the same time at one operation, which machinery, when combined with electrical or galvanic apparatus, is capable of effecting the operation of immediately any characters which may be selected by the compositor, even though the printing press be removed to a distance from the composing machine; and therefore, I design, by the use of certain electrical apparatus, as improved by me, to apply, among other things, the said machinery to the publishing messages in ordinary typography, and also signalizing messages at great distances, as means of communicating intelligence.

Claim.—"What I claim as my own invention is, 1st, The employment of electro-magnetic force, in combination with the force of a current of air or other fluid, so that the action of the former governs or controls the action of the latter for the purpose described.

"2d, I claim the construction of the electro-magnet as described, that is to say, a series of fixed magnets in combination with a series of movable magnets, arranged upon a central axis, which axis plays between or through the line of fixed magnets, so as to effect a vibratory movement of said axis by a force multiplied by the number of magnets of both kinds.

"3d, I claim the combination of the electro-magnet with the valve, for regulating and directing the force of a current of air or other fluid, acting as a motive power upon the piston, or other analogous device, for producing a vibratory motion, as described.

"4th, I claim the endless band, in combination with the cylinder, as an inking machine, for conveying and applying the coloring matter to the paper at the moment of receiving the impression from the types, as described.

"5th, I claim the combination of the regulating bar with the type wheel for the purpose of regulating the proper position said wheel should have in connexion with a given position of the key shaft, at the moment of printing any letters or characters."

69. *For Machinery for Heading Bolts, &c.;* Edward Paye, Albany, New York.

Claim.—"What I claim as my invention is, 1st, The combination of the stationary die and die pivot with the sliding hammers, actuated by the rotary grooved cams or cam collar, substantially as described, for the purpose set forth.

"2d, The revolving ring or cam collar, provided with cams or their equivalents, on its inner and outer surfaces, when arranged with radial compressing and sliding upsetting hammers, in the manner and for the purposes described."

70. For an *Improvement in Shuttles for Looms;* Wm. Tucker, Blackstone, Mass.

"The object of my improvement is to prevent the weaving of 'bad places' in cloth, or the consequences that generally result from the breakage of one of the warp threads; when this occurs, the movements of the lay so entangle the loose, broken warp threads in the adjacent warp, as to cause the latter to make an improper decussation, whereby, what weavers term a 'bad place' will be woven or made in the cloth, until the broken warp-thread is repaired.

Claim.—"What I claim as my invention is, the combination of the elevator, the bent spring, the platform, and its recess, the passage and the slot, as applied to the shuttle and cop spindle, and made to operate together, substantially in manner and for the purpose of causing the filling thread to be broken, so that no filling thread shall be woven into the warps, under circumstances as hereinbefore stated."

71. For an *Improved Method of Heading Screw Blanks, Rivets, &c.;* Wm. E. Ward, Portchester, New York.

Claim.—"What I claim as my invention is, in combination with the swedge-header and die-plate, substantially as specified, the giving of a back or receding movement at the end of the heading operation to the follower, against which the point of the rod rests during the heading operation, substantially as specified, that the rod or wire may be upset, outside of the die, whilst resistance is made by the follower against the end of the rod, and then as the follower retires, cause the part so upset to be griped between the surface of the die and the swedge, to complete the form of the head, the surplus metal being thereby forced into the blank, as set forth."

72. For an *Improved Safety Apparatus for Steam Boilers;* Henry Waterman, Williamsburg, New York.

Claim.—"What I claim as my invention is, 1st, The safety chamber and safety plate, combined with the boiler in any way substantially as described, whereby the bursting of the plate by the too high pressure in the boiler, causes the chamber to be filled, and the pressure in the boiler to be reduced by the expansion of the steam.

2d, The plate placed, substantially as described, between the boiler and the safety plate, having one or more small openings, through which the steam is allowed to pass, to act on the safety plate and fill the safety chamber, whereby the water is prevented from priming or foaming, and being carried up by the steam when the safety plate bursts."

73. For *Machinery for making Railrood Chairs;* John F. Winslow and John Snyder, Troy, New York.

Claim.—"We have described the mode of construction and arrangement, which we have essayed with success; but we do not wish to be understood as confining ourselves thereto, as the construction and arrangement may be greatly varied, without changing the principle of our invention.

"What we claim as our invention is, the movable cutter for making the cuts in the edges of the plate, substantially as described, in combination with the slides, which answer the purpose of stationary cutters and rests, to effect the partial bending of the lips, and which afterwards complete the bending of the lips, substantially as described.

"We also claim, in combination with the cutter, as described, the making of the mould or former to slide therein, for discharging the chair after it has been formed as described.

"And finally, we claim the dies for upsetting and giving additional thickness to the lips, as described, in combination with the bending slides and cutters, substantially as described."

74. For an *Improvement in Daguerreotyping;* Wm. Yarnall, Newark, Ohio.

"The nature of my invention and improvements consists in chemically producing ornamental borders or marginal designs of a variety of hues and tints, colors and shades, or encircling the photographic image with a succession of circles, halves and irradiations."

Claim.—"What I claim as my invention is, the producing ornamental borders and designs of different shades and forms, and singly or in numbers, around any photographic image, by the method of irregular chemicalization, combined with the use of pattern slides, or chemical cut-offs, all of which is fully described in the detail of my process."

DESIGNS FOR DECEMBER, 1852.

1. For a *Design for a Cook Stove;* Ezra Ripley and N. S. Vedder, Troy, Assignors to Samuel McClure, Rochester, New York, December 7.

Claim.—"Having described our design of cook stove, what we claim as new is, the ornamental design and configuration of cook stove, such as herein described."

2. For a *Design for a Box Stove;* James Wager, Volney Richmond, and Harvey Smith, Troy, New York, December 14.

Claim.—"Having fully described our design, what we claim therein as new is, the foregoing configuration of the ornaments upon the plates, forming an ornamental design for a stove, illustrated and represented by the drawings."

3. For a *Design for Iron Railing;* Nicholas T. Horton, Cincinnati, Ohio, December 14.

Claim.—"What I claim as my invention is, a design for ornamental iron railings, as described in the above specification."

4. For a *Design for a Coal Stove;* Gilbert Knapp and Adnah H. Neal, Honesdale, Pennsylvania, December 14.

Claim.—"What I claim as my invention is, the ornamental design and configuration of the stove and door, and also the ornamental openings, in combination with the different mouldings, as herein shown and described."

5. For a *Design for Stove Plates;* Sherman S. Jewett and Francis H. Root, Buffalo, New York, December 21.

Claim.—"Having described our ornamental design for stove plates, what we claim as new therein is, the embellished panel of the plate, of the configuration herein represented and described."

6. For a *Design for a Cooking Stove;* Sherman S. Jewett and Francis H. Root, Buffalo, New York, December 21.

Claim.—"Having described our ornamental design for cooking stoves, what we claim as new therein is, the configuration and arrangement of the several devices ornamenting the panels and doors, the same consisting of annular mouldings surrounding the apex of a dished or hollow cone surface, formed of converging fillets, whose outer ends form a scolloped outline ur border for the panel, as represented and described."

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7. For a *Design for a Hearth Plate;* James Wager, Volney Richmond, and Harvey Smith, Troy, New York, December 21.

Claim.—"Having fully described our design, what we claim as new is, the foregoing design for a stove, as illustrated and represented by the drawings."

8. For a *Design for a Spittoon;* Washington L. and Sylvester W. Pearsall, City of New York, December 21.

Claim.—"We claim the design of the shape and configuration of spittoon shown in the drawing."

9. For a *Design for a Girandole;* Robert E. Dietz, City of New York, December 28.

Claim.—"What I claim as my production is, the arrangemen tand combination of the foliage, drapery, human figures, and flowers, as set forth in the accompanying drawings, forming an ornamental design for a girandole."

JANUARY 4TH.

1. For an *Improvement in Machines for Heckling Flax and Hemp;* James P. Arnold, Louisville, Kentucky.

Claim.—"I do not confine myself to any particular form or arrangement of the parts, so long as the machine is so constructed that it will operate substantially in the manner herein set forth; the form I have described and represented is the one that I have essayed with success, and therefore deem it sufficient to show how my invention may be practically carried into effect.

"What I claim as my invention is, the method of heckling hemp by subjecting it to the action of a series of mixed beaters and combs, the teeth of the latter being of varying length, some of them projecting so far, and others beyond the beaters, and the whole operating substantially in the manner herein set forth.

"I also claim a rest, having a narrow slot open at one end, in combination with a concave, projecting beyond the end of the cylinder at the open end of the rest, substantially in the manner herein set forth."

2. For an *Improvement in Machines for Sawing Stone;* John T. Bruen and James G. Wilson, Hastings, New York.

Claim.—"What we claim as our invention in the sawing of marble and other stone is, lifting the saws at or sufficiently near the middle of the stroke, to effect the herein specified purpose, substantially in the manner specified.

"We also claim interposing india rubber, or its equivalent, between the ways and the inclined projections which lift the saw-frame, substantially in the manner and for the purpose specified."

3. For an *Improvement in Self-Winding Telegraphic Registers;* James J. Clark, Philadelphia, Pennsylvania.

Claim.—"I do not desire to claim the application of the click and ratchet wheel, operated by an electro-magnet, vibrating a lever, to cause rotation and obtain power; but what I do claim is, regulating the current through the coil of the electro-magnet of the self-winding apparatus by means of the relative motion of the spring shaft and spring box, so that when the spring has been wound up to a certain point that current shall be cut off, and the self-winding apparatus cease to act."

4. For an *Improvement in Machines for Planing Mouldings;* John D. Dale, Philadelphia, Pennsylvania.

"The nature of my invention consists in arranging a series of moulding cutters or plane irons, side by side, and along the length of and around an axis of rotation, when this is combined with rotating saws or their equivalents, for slitting or separating the several mouldings at the same operation, whereby the operations are not only simplified, but accurate work is insured."

Claim.—"What I claim as my invention is, arranging a series of sets of moulding cutters or plane irons, side by side, along the length of a rotating stock, substantially as specified, when this is combined with rotating saws, or their equivalents, interposed and projecting beyond the periphery of the cutter for separating the several mouldings formed on one plank, substantially as specified, whereby the operations of planing the several mouldings, and separating them, are performed at one and the same operation, and accuracy of work secured, as set forth."

5. For an *Improvement in Machines for Planing Mouldings;* John D. Dale, Philadelphia, Pennsylvania.

Claim.—"I do not wish to limit myself to the number of knives or rollers to be used, nor to the manner of operating the rollers, as these may be varied at pleasure. And I wish it to be understood, that I do not wish to limit myself to the use of all my improvements in one machine, although the best results will be produced by the employment of all of them.

"What I claim as my invention is, attaching the planing iron to a plane stock, which is hinged to an adjustable sliding plate, substantially as specified, by means of which combination the plane iron can be readily thrown up, to be sharpened, without the necessity of taking it out of the machine, as set forth.

"I also claim the adjustable sliding plane, substantially such as described, when combined with the separate movable mouth piece, by the means substantially such as herein described, so that in setting the plane iron, a differential motion is given to the mouth piece, in order to vary to any desired thickness the shaving, that when the plane is set to cut a thick or thin shaving, the mouth piece shall receive a corresponding set, as described."

6. For an *Improvement in Grain Washers;* George Feaga and George W. Feaga, Frederick, Maryland.

"The nature of our invention consists, First, In washing the grain in water, by which means the smut is loosened, and in which the smut, garlic, and all other light impurities will rise and pass off with the water, and then carrying the washed grain by elevators or otherwise, and passing it over or through a chamber or chambers, heated by steam or hot air, where it is thoroughly dried, and thence to the stones for grinding."

Claim.—"Having thus fully set forth the nature of our invention, and shown the means of putting it into practical use, what we claim therein as new is, the method herein described of separating grain from smut, garlic, and other impurities, by first washing it in a trough or reservoir of water, where the separation takes place, and then conveying the washed grain to a drying apparatus, where it is thoroughly dried—the whole operation being performed substantially in the manner herein set forth and described."

7. For an *Improvement in Crutches;* John S. Gallaher, Jr., Washington, D. C.

Claim.—"Having described the construction and operation of my improved crutch, what I claim is, First, The revolving plain or corrugated spring top, in combination with an air cushion, substantially as above described.

"Second, I claim, in combination with the revolving spring top, the sliding joint applied to the staff of a crutch, in the manner and for the purpose described.

"Third, I claim, in combination with the sliding staff, the revolving handle, extension ferrule, and elastic bulb, as above described and set forth in the accompanying drawing."

8. For an *Improvement in Hill-side Ploughs;* John C. Bidwell and John Hall, Executors of Samuel Hall, deceased, Pittsburg, Pennsylvania.

Claim.—"What we claim as the invention of Samuel Hall is, the manner of arranging the mould boards upon the land-side, to wit: placing their hinges at such a distance from each other, on each side of the centre of the land-side, that each mould board may be supported by the edges and projection as far as practicable, from the hinges, and rest upon the grooves near the middle of the land-side, substantially for the purposes herein set forth."

9. For an *Improvement in Hose Pipes;* Richard Hollings, Boston, Massachusetts.

Claim.—"What I claim as my invention is, hanging the spread to the hose-pipe by means of pins passing through the collar, (which allow it to vibrate,) in combination with adjusting apparatus for varying the position of the spread, in the manner specified."

10. For an *Improvement in Lathes for Turning Irregular Forms;* Benj. F. Jenkins and Luke L. Knight, Barre, Massachusetts.

"This invention relates to that description of lathe, in which the work and cutters both revolve, and the irregularity of form is produced by the vibration of the axes of the work, and of the whole or part of the cutters—the improvements consist in certain simple and effective means of controlling the vibrations of the said axes."

Claim.—"We do not claim the vibrating cutter cylinder and vibrating work carriage, but what we claim is, giving the necessary relative vibrations to the cutter cylinder and work carriage by crank pins or eccentrics, upon the axes of a pair of toothed wheels, of which one is toothed all round its periphery, and the other upon any suitable portion of its periphery—the latter wheel having a constant rotary motion applied, which gives an intermittent rotary motion to the former wheel, whereby the said cutter cylinder and work carriage receive, the one a constant vibratory motion, and the other an intermittent vibratory motion, substantially as described."

11. For *Improvements in Ore Washers;* Merritt Peckham and Lucius O. Palmer, Utica, New York.

Claim.—"We claim as our invention, the interior cylinder with indented ends and wings, attached as described, to operate as a discharging apparatus, attached to the interior of an inclined revolving screen, in the manner and for the purpose specified."

12. For an *Improvement in Potato Diggers;* Francis C. Schaffer, Brooklyn, New York.

"The nature of my invention consists in the arrangement and construction of an endless apron and scoop, which will be hereafter described, and by which arrangement and combination potatoes are dug and scooped from the hills, and conveyed by the aid of a brush cylinder into a proper receptacle or box, the potatoes being thoroughly cleansed from dirt, in consequence of passing up the inclined apron."

Claim.—"I am aware that machines have been previously used for digging potatoes, but in these machines the potatoes are dug or scooped from the hills by means of a concave or scoop, formed of a single piece, the brush cylinder carrying the potatoes up the concave and into the receptacle. I therefore do not claim the above arrangement, but what I do claim as new is, the arrangement and combination of the scoop and endless apron, by which the potatoes dug or scooped from the hills, and the dirt thoroughly separated therefrom as they pass up the endless apron into the receptacle."

13. For an *Improvement in Tonguing and Grooving Machines;* William Watson, Chicago, Illinois.

Claim.—"Having thus described my improvements in tonguing and grooving machines, what I claim therein as new is, the method substantially as herein described, of tonguing and grooving boards by means of knives arranged in the plane of the sides of the tongues or grooves, with their cutting edges inclined towards their rear extremities, so as to cut gradually deeper and deeper as the board passes them, when in combination with cutting instruments arranged between these side knives, to reduce or remove the surplus wood which is severed by them, substantially as herein specified."

14. For an *Improvement in Printing Presses;* Jeptha A. Wilkinson, Fireplace, New York.

Claim.—"I am not aware that type have ever been formed with two parallel sides and two sides tapering on the radii of a circle, with a groove on one side and a projection on the other, so that on setting the parallel sides together and the tapering sides together, and placing the projecting beads into the corresponding grooves, a cylinder is formed of firmly secured type, with their faces equi-distant from the centre, by which means the printing is effected, the same as though the whole was solid in a perfect cylindrical form; this constitutes the essence of my invention, and the other parts claimed are the means to use, to form, regulate and work this main invention, and for parts growing out of or connected with the same.

"1st, The application of notches or grooves and beads or projections on the shafts of type, tapered to the radii of a circle, for the purpose of locking said type together, and securing it in place on a cylinder, substantially as described and shown.

"2d, The mode described and shown, of forming column lines, rules, rings, and blocking, so that they are adapted to the cylinder and to the type, with notches and projections, to lock into the type and cylinder, substantially as described and shown.

"3d, The mode described and shown, of constructing the type cylinder with heads, the one head having a bead or projection, the other with a notch or groove around in its face near the edge, for the purpose of receiving and securing the type or other parts composed on the surface of said cylinders, such heads being fitted with means to compress and hold the type and parts in a cylindrical form, for the purpose of printing, by a rotary movement, substantially as described and shown.

"4th, The mode of constructing the compositor's sticks in the form of a part of a cylinder with flanches having beads or grooves, so as to hold the type in segments of a circle while composing or setting up, preparatory to the placing of the same in the galley or proof cylinder, substantially as described and shown.

"5th, The mode of constructing and applying the galley or proof cylinder, so that it shall receive and hold the type, in circular form, from the composing stick, and retain the type and the needful parts in place, for correction and proof, and for transferring the same to the type cylinder, the parts being constructed and operating substantially as described and shown.

"6th, The mode of forming and constructing the type-holder or grab, to enclose, take hold of, and securely lift a mass of type from the galley, or proof cylinder, and transfer the mass either to the type cylinder, or to a stack for future use, or to reverse or vary either of these operations as may be needed, the instrument being constructed and operated in the manner and with the effects described and shown.

"7th, The application and arrangement of the pulleys, bands, and guide plates, so placed and moving, so as to carry the sheet of paper from the press in lines diverging vertically, and converging horizontally, under, between. and over the guide plates, thereby presenting the paper in a folded form to the compressing rollers, substantially in the manner and with the effects described and shown.

"8th, The application of the press rollers, to compress the folded paper and lead that out of the folding apparatus, and the combination of the standing roller, revolving shear, standing shear, valve, and cam, to effect the cutting of the folded paper as it issues from the rollers, and guide the fresh cut edge clear of the standing shear, the whole of the parts being constructed, arranged, combined, and operating substantially as described and shown."

15. For an *Improvement in Covering Piano Forte Hammers;* Rudolph Kreter, Assignor to Robert Nunns and John Clark, City of New York.

Claim.—"What I claim as my own invention is, First, The application of the felt or other covering material to the whole set of hammer heads at one operation, in the manner described.

"Second, I claim the clamp, bar, levers, pulleys, and block, with the sliding frame, in combination, substantially as described, but without limiting myself to the precise shapes and proportions or positions of the said parts, provided the arrangement embrace the means of holding the set of hammer heads, and of bringing them to bear upon a table containing the strips of felt described, and also holding and moving the whole together either horizontally or vertically to and from the jaws of the vise, as set forth.

"Third, I claim the vise in combination with and in closing the bar and block, as described.

"Fourth, I claim the lip pieces in combination with said vise, for the purpose described.

"Fifth, I claim the levers and springs in combination with the vise, for producing the pressure upon the sides of the felt during the passage of the hammer heads between the jaws of the vise, as described.

"Sixth, I claim the method of increasing or diminishing the pressure of the levers upon the vise by means of the movable bridge in combination with the press, as described."

16. For an *Improvement in Bottle Stoppers;* Walter Hunt, Assignor to Chas. T. Kipp, City of New York.

Claim.—"I am aware that there have been other plans of self-acting stoppers, recently introduced; I allude to the bi-valves, hinged at the top, which, in short, is nothing more than the valve of the treacle cup duplicated, and its application to rum instead of molasses; there are also other plans of recent date, which have sprung up since mine were commenced, constructed upon the principle of puppet valves, all of which have the same objection, of producing an uncertain scattering or over discharge, and are constructed upon principles widely different from my above described plan, and to which I make no claim in this application. But what I do claim is. the combination of the circular cap and the central shaft, viz: the swivel, pendulous and sliding motions, by means of which without regard to which side of the stopper is upward, (when it is placed horizontally, or nearly so,) the under portion of the cap swings off from the flanch. thereby producing a downward opening between the two, for the requisite discharge of the liquids contained."

MECHANICS, PHYSICS, AND CHEMISTRY.

On Improved Fire Brick Gas Retorts. By Mr. John E. Clift.*

The object of this paper is to describe a plan for constructing gas retorts, which the writer has had in use several years at the works under his management, and has also adopted at various other towns.

The first great desideratum in a gas generating retort is on all hands acknowledged to be a large surface, upon which may be spread a thin layer of coal: this was early shown by Mr. Clegg, in his invention of the revolving web retort,—the only difficulty in working which was the destructible nature of the material of which it was composed.

The second condition required is, that this large surface shall be economically heated. A strong opinion existed, for a long time, against the use of fire clay for retorts, in consequence of the inferior heat-conducting properties of that material compared with iron; but experience has proved that as large a quantity of gas can be generated, with a given weight of fuel, with fire clay retorts as with iron. This may be accounted for partly by the fire clay losing less of its heat on being exposed to the air whilst charging, and on the cold charge of coal being first thrown in; or, in other words, that the greater mass of fire clay acts as a reservoir of heat, and does not become so readily exhausted when a large demand is made upon it, but, on the contrary, maintains a greater uniformity of temperature throughout the process: this is easily demonstrated by observing the small quantity of gas made from an iron retort, during the first hour after charging, compared with a fire clay one. It is also partly accounted for by the iron retorts, as they are generally set, being so covered and shielded with fire bricks, to preserve them from destruction, as to partake as much of the character of clay retorts as of iron.

The following table, which is the average of a number of experiments, gives the quantities of gas generated, as indicated by the meter, from iron and clay retorts, during each half hour of the charge, from the same quantity and quality of coal:—

IRON RETORTS.				BRICK RETORTS.			
1	half hour,	250	cubic feet.	1	half hour,	480	cubic feet.
2	"	630	"	2	"	1800	"
3	"	1340	"	3	"	2000	"
4	"	2300	"	4	"	2000	"
5	"	2600	"	5	"	2300	"
6	"	2640	"	6	"	2300	"
7	"	2600	"	7	"	2460	"
8	"	2600	"	8	"	2400	"
9	"	1700	"	9	"	2000	"
10	"	1630	"	10	"	1630	"
11	"	1790	"	11	"	860	"
12	"	700	"	12	"	550	"
	Total,	20780			Total,	20780	

The third requisite in a retort is durability. The proper way to measure this element is to divide the quantity of gas made, by the cost of the retorts and ovens, and the repairs during the time they are worked: this will be shown presently by a comparison from the actual working of iron and clay retorts.

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* From the London Journal of Arts and Sciences, October, 1852.

The retorts to be described in the present paper are composed entirely of fire bricks, with cast iron front plates to attach the mouth pieces to, and to bind the brickwork together; and they are made of any length, width, or height. They are generally constructed in sets of three, with one large retort above and two smaller ones beneath, as shown in the drawings which accompanied the paper. The cast iron front plates are $1\frac{1}{8}$ inch thick. The wrought iron stays for the same are 4 × $1\frac{1}{2}$ inches, and are fastened at the bottom by cramps built into the brickwork, and at the top by tension bars, connected to similar stays on the opposite side.

The two lower retorts are 15 inches wide, 15 inches high, and 20 feet long, with a mouth piece at each end. The fire bricks, forming the bottoms and sides of the retorts, are 16 inches long and 3 inches thick; and the arch bricks, forming the top, are 9 inches long by $3\frac{1}{2}$ inches deep. Each brick is rebated 1 inch deep in the transverse joints, and grooved in the longitudinal joints; and these grooves are filled with stiff fire clay when they are put together, which burns into a hard tongue, half an inch thick, as it becomes heated: the object of these tongues is two-fold,—they offer a resistance to the leakage of the gas by breaking the joint, and they tie together the arch of the retort.

The large upper retort is 5 feet 3 inches wide, and 20 feet long, and open for charging at both ends. The bricks are similar to those forming the small lower retorts. There is a cross arch, 5 inches thick, spanning the furnace flat on the top, which covers the under side of the transverse joints of the bottom of the large retort; and the longitudinal joints are covered by small arched bricks. Two furnaces are employed, one at each end of the oven, separated by a transverse wall. In rising from each furnace, the heat passes partly underneath and partly over the small retorts into the first flue, at either side of the large retort; and thence it proceeds through a series of flues above that retort into a main flue leading to the chimney. By this arrangement, the heat is caused to pass over 50 feet length of surface of retort from the time it leaves the furnace until it reaches the main flue.

With regard to durability, the writer states that 12 sets of these retorts were put up by him in 1842, and worked constantly, with the exception of short periods, up to 1849, when they were taken down for the alteration of the works, and they were found then in good condition, and were fit for working several years longer with slight repairs. The writer also put up 12 sets of these retorts in 1844, and they continue in regular work now, and are in good condition: the cost of repairs of the retorts, ovens, and furnaces, during the eight years they have worked, has not exceeded 20*s*. per annum for each set.

The writer accounts for the durability and economy of retorts constructed on this plan, firstly, by their being composed of a great number of pieces, instead of only one; so that when their temperature is altered, either by the carelessness of the stokers, or in letting down the heat to throw the retort out of work, each joint opens a little, equal to the contraction of a 9 inch brick, and prevents any portion of the retort cracking. In the same way, in getting up the heat (which is a time when a great number of clay retorts made in one piece are destroyed), if one portion of the retort becomes heated more than another, the joints accommodate the expansion; or, if the brickwork is in a very green state, and the expansion from the moisture is great, the screws of the tension rods may be eased, which will allow the whole mass of brickwork to swell; but, as soon as the moisture is expelled, it will sink back into its place, and be as perfect as when first built. When a set of these retorts is first put to work, either new, or after being let down for any purpose, it leaks through the joints for about 24 hours, gradually stopping; and, after that time, if the heat be good, it will have become quite sound, and permanently gas tight, under a pressure equal to 10 or 12 inches head of water.

From a sufficiently long experience, the writer has proved that brick retorts, built upon this plan, will wear for 10 years, with the outlay of 20*s.* per annum for repairs, and that iron retorts will not last more than 1½ years, under the most favorable circumstances. Then to show their comparative economy, take a number, say 20 sets or beds of iron retorts and 20 beds of brick retorts,—each bed being capable of making 20,000 cubic feet of gas in 24 hours; and to make the calculations as correct as possible, let the cost and repairs of each be estimated, and the quantity of gas they will make, during a period of 10 years, in order to ascertain the cost of the gas produced from each plan per 10,000 cubic feet.

First cost of 20 beds of iron retorts:—			
Bricks, clay, and labor, for arches,			£367 0 0
100 cast iron retorts, 18 cwt. each, 90 tons, at £6,			540 0 0
Fire bricks, shields, quarries, &c., for setting,			150 0 0
Labor for setting, 60*s.* each set,			60 0 0
Cost of renewing 20 beds of iron retorts:—			
100 iron retorts, 90 tons, at £6,		£540 0 0	
Bricks and clay,		150 0 0	
Labor, taking down, and resetting,		80 0 0	
		£770 0 0	
Less by old burnt iron, 50 tons, at 25*s.*,	£62 10 0		
Less by one-third of bricks, which may be used again,	50 0 0		
		112 10 0	
		£657 10 0	
This sum will be multiplied by 6½ the number of times they will be renewed in 10 years, which will give			4270 10 0
Making the total expense of iron retorts,			£5387 10 0

First cost of 20 beds of brick retorts:—		
Bricks, clay, and labor, for arches,		£367 0 0
Iron for front plates and brick stays, 21 tons, at £6,		126 0 0
Pattern and other bricks and clay for retorts,		180 0 0
Labor for building retorts,		110 0 0
		£783 0 0
Cost of repairs for 10 years, at 20*s.* per bed per ann.,	£100 0 0	
Less value of old front plates, &c., 20 tons, at 25*s.*,	25 0 0	
		75 0 0
Making the total expense of brick retorts,		£858 0 0

Now, as the quantity of gas that each of the two descriptions of retorts is estimated to generate is the same for 10 years, namely, 1460 millions cubic feet, it follows that the gas from the cast iron retorts costs 9*d.* per 10,000 cubic feet, and that from the fire brick retorts 1⅓*d.* per 10,000 cubic feet, for the item of retorts and ovens; showing an economy of 84 per cent. in the improved fire brick retorts.

Mr. Chellingworth inquired whether a defect in a brick retort could be repaired, such as a bad joint? When an iron retort became broken, it could not be repaired, and was all lost, and had to be pulled out; but it was a great advantage in the brick retorts if they could be readily repaired.

Mr. Clift replied, that a defect could be easily repaired at any time, without stopping the working of the retorts. The surface of the retorts could be thoroughly examined through the different sight holes of the oven, and any defective joint detected by the appearance of a gas flame; and a single brick could be taken out of any part when required, and removed by proper tools through the sight holes, which were made large enough for a brick to pass; and another brick was then set in its place with fire clay, without occasion to let down the heat of the retort. When a brick retort was pulled down, it was found that the carbon deposited from the gas filled up any crack or fracture, by the carbon adhering to the rough surface of the brick and collecting upon it, from the indestructible nature of the brick. But a crack in a cast iron retort continued getting worse, and became constantly more open, on account of the surface of the iron perishing in the sides of the crack, which prevented it from getting closed up by a deposit of carbon, as in the brick retorts. When a cast iron retort was once cracked it was done for, and must be thrown away, requiring the whole oven to be opened out and rebuilt, and causing a serious delay to the work, as well as expense.

Mr. Ramsbottom remarked, that the greater equality in the rate of expansion by heat of carbon and fire brick, than of carbon and cast iron, would probably assist in keeping the joints close.

Mr. Clift observed, that on pulling down the brick retorts, after seven years' working, it was found that the joints were completely blackened, and filled with carbon half way through, up to the fire clay stopping in the centre groove; but the outer half of the joints showed no appearance of the carbon having passed the groove. The plan of constructing the retorts of double the usual length, with a mouth piece at each end, he had only had in use for about a year; but he found it a decided improvement, and had since adopted it in all new works. The other retorts became scurfed up with a large accumulation of carbon, particularly at the back ends, where the scurf became several inches thick, and very hard; and the retorts had to be stopped work, and the heat let down, usually every eight months, for the purpose of clearing out this scurf, and getting it detached by the contraction in cooling. But in the long retorts, open at both ends, there was no back for the scurf to accumulate, and the current of air through the retort, every time that both ends were opened, caused the scurf to scale off, and it was much easier to detach; and consequently, it was found that they would work much longer before requiring to be let down. Also, the centre portion of the oven, which is the hottest part, and most valuable for making gas, was lost before by the blank ends of the retorts, but is now made available, as there is only a single brick wall dividing the flues; and by this means, the heating surface and contents of the retorts are increased, without any increase in the size or expense. Another advantage is found in preventing the injury and shaking of the joints that was caused in drawing the coke from the retort by the heavy rake being driven against the back of the retort.—*Proc. Inst. Mech. Eng., Birmingham, July 25th*, 1852.

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*Description of the Steamship Arabia.**

Messers. Robert Steele and Co. launched from their building yard on the 21st of June, the steam vessel *Arabia* (late the *Persia*). At the time appointed, ½ past 2, P. M., as the vessel began to move, she was named the *Arabia* by Miss Louisa Myles, daughter of the Rev. Mr. Myles, of Glasgow. Amongst the gentlemen present at the launch were the Messrs. Burns, of Glasgow, Mr. M'Ivor, of Liverpool, &c.

Dimensions.	feet.	tenths.
Length on deck, ...	284	2
Breadth on deck amidships, . .	37	3
Depth of hold amidship, . .	27	6

Tonnage.	tons.
Sectional act, ...	$2393\frac{42}{100}$
Act for foreign vessels, . . .	$2250\frac{60}{100}$

A pair of sway-beam engines, by Mr. Robert Napier, Vulcan and Lancefield foundries, Glasgow, of 910 horse (nominal) power; diameter of cylinders, 103 inches × 9 feet length of stroke; diameter of paddle wheels, 37 feet; having tubular boilers, and 2 funnels, &c.

The builders have taken a hint from Brother Jonathan, and moulded the *Arabia* sharper forward than any of the Company's vessels that have been previously built, and the after run is probably one of the finest and most elegant series of curves, from a vertical straight line to a long flat floor and full round bilges, ever seen. The desiderata of a fine entrance and run have been attained, consistently with large available space and tonnage, owing to the great length, which is seven times the breadth, while there is ample space for a midship line, without injuring the easy curves at either extremity, so requisite to ensure fast sailing. From the great length, and the immense weight of the machinery to be put on board, she required to be more than usually rigid. This extra strength has been attained by two series of diagonal iron bracing, extending from the main deck beams down to the bilges. The braces are bolted by through bolts to every timber which they cross. The first series of braces are sunk or checked flush into the timber, the second series lying over them. No amount or disposition of timber could possibly give the strength or rigidity which this complete system of iron bracing effects.

The sleeping accommodations are all arranged under the main deck, and extend the whole length of the vessel fore and aft. There are two berths to every state room, placed fore and aft, an advantage and comfort which voyagers alone can fully appreciate. The state rooms are thoroughly ventilated by spacious louvres, fitted with glass, opening into the passages, and they communicate, in their whole length, with the open air above, through a continuous lateral opening under the seats on each side of the saloon on deck. The saloon extends the whole length of the vessel, affording an unbroken promenade from stem to stern. This is a great improvement upon the detached houses on deck, as hitherto adopted, and affords a vastly increased accommodation, without interfering with the ship-shape of the vessel, or the requisite facilities for handling or working her. The *Arabia* is owned by the British and North American Royal Mail Steam Navigation Company, and is to ply between Liverpool and New York.

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* From the London Artizan for September, 1852.

DESCRIPTION.

A bust female figure head, no galleries, round sterned, and carvel built vessel, three decks (flush), stationary bowsprit, two masts, brig-rigged, port of Glasgow. Commander, Mr. Charles Henry Evans Judkins. Arrived at Lancefield Quay, Glasgow, from Greenock, to receive the machinery, &c.

For the Journal of the Franklin Institute.

The Caloric Engine.

The past month has witnessed the trial of an experiment to which the engineering world has looked forward with an unusual degree of interest, due, perhaps, as much to the boldness of the attempt as to the influence its success was expected to produce on the progress of the Mechanic Arts. Curiosity had been still further stimulated by the jealous care exercised in preventing the visits of strangers to watch the progress of the experiment, and by the air of mystery in which the whole affair was enveloped.

At length, however, the veil has been removed. On the 15th day of December, 1852, the engines of the *Ericsson* were put in motion by the power of compressed air, and two trials have since been made in New York harbor on the 4th and 11th January, 1853. The performance of the engines and speed of the ship on those trials have been reported by the newspapers in statements of a nature so contradictory and extravagant, that those who desire to form a judgment respecting the ultimate success of the enterprise, find it difficult to obtain from those sources the requisite data. By a little inquiry, however, we have ascertained the facts which were then observed, and believe the following account of them to be deserving of credit. We propose, after giving that account, to discuss the question, "whether atmospheric air can supersede steam as a motive power in the propulsion of ships?"

We shall, in the first place, describe briefly the principles of construction and operation of the caloric engine, referring those of our readers who desire further information, to a statement embodying the specification and patent claim which appeared in this Journal in October, 1851, (vol. xxii. pp. 229–231.)

Two cylinders of different diameters are placed one above the other, their inner ends open to the atmosphere, and are provided with pistons connected together; the smaller one (above) is termed the *supply*, and the other the *working* cylinder. A vessel called a receiver, of a volume at least equal to the former of these, and another termed a regenerator, containing a large quantity of wire cloth or other metallic substances presenting an extended surface, are connected with the cylinders in such manner, that all air passing *from* the supply must pass through the receiver on its way to the working cylinder, and that all air either entering or leaving the working cylinder must go through the regenerator. A self-acting valve in the piston, opening inwardly, permits the entrance of air from the atmosphere to the upper end of the supply cylinder, (the lower end being open.) A self-acting valve opening outwardly governs the passage from the supply cylinder to the receiver. And other valves are so placed as to regulate the passage of air to or from the lower end of the working cylinder. A furnace is built beneath this latter, in which is consumed all the fuel required for propulsion.

It will be understood that the supply cylinder is merely a pump to supply the other with air; that the receiver is a sort of magazine for the storage of this air when compressed by the pump; that this air is expanded in volume by heat, so as to maintain it at the same pressure, while filling the superior capacity of the working cylinder; and that the regenerator is a magazine in which is stored the heat given out by the hot air escaping, to be given back to the cold air, going into the working cylinder to perform the next stroke. Finally, that with a limit of temperature and point of cutting off, the size of the supply cylinder governs the pressure of air at which the engine is worked. The operation of the machine is as follows:

The pistons being at the bottom of the stroke, air is pumped into the receiver until it has the desired pressure. A fire having been kindled under the working cylinder, this air becomes expanded and the piston ascends, pushing before it the supply piston, which at some point in the stroke (depending on the pressure in the receiver), compresses the air above it so as to open the valve into the receiver; this continues open till the termination of the stroke. Meantime, the inlet valve of the working cylinder being open, the latter is taking from the receiver a volume of air equal to that forced in it by the supply piston. But in its passage along he heated surfaces, the temperature is raised and its volume therefore expanded so as to retain its initial pressure, and yet fill the greater displacement under the working piston. Arrived at the top of the stroke, the outlet valve of the working cylinder is opened, the pistons descend by gravity, and the air escaping through the regenerator leaves a portion of its heat. When the pistons again reach the lowest point of their movement, the outlet valve is closed—and on the inlet valve being opened, the air stored in the receiver again passes through the regenerator into the working cylinder, taking up in its passage the heat remaining in the wire cloth—and so the engine continues to perform its functions. The furnace under the cylinder is merely for the purpose of supplying that part of the heat which the regenerator will not take up. The powers of this latter, therefore, are an index of the economy of the machine. The flow of air into the working cylinder may be cut off at any part of the stroke.

The advantages claimed for this method of obtaining power are numerous, but there are three which, from their importance, deserve serious consideration. They are—

1st. Economy of fuel, amounting to about $\frac{9}{10}$ths of that ordinarily required to develop equal power with steam.

2d. Economy of space required for the machinery and the coal necessary for a voyage.

3d. Superior safety from the diminished risk of fire and explosion.

After giving the dimensions of the ship and engines, and the results noted on the trial, these will be considered seriatim.

Proportions of Hull.—The *Ericsson* is a vessel of 250 feet in length, 40 feet beam, and 22 feet 6 inches hold, built in the strongest manner, of beautiful mould and finish, and said to possess every qualification for great speed; constructed expressly for the purpose of trying Capt. Ericsson's engines.

Draft of water on trial, 16 feet 9 inches, with her machinery and 200 tons pig iron on board.

Proportions of Engines.—The engines have four working cylinders 168 inches in diameter, 6 feet stroke; 4 supply do., 137 inches in diameter, 6 feet stroke, and are placed two forward and two abaft the shaft; both pairs connected to one crank pin by connecting rods attached to lever beams, to which also the pistons are connected by links, &c. Her working pistons are hollow, about six feet deep, and filled with non-conducting substances. Packing is on the upper side, and never rubs on surface directly exposed to the heat. The working cylinders have beneath them receptacles filled by the pistons at the lowest point of the stroke, the bottom and sides of which are exposed to the fire in the furnaces beneath. Space occupied by the machinery 76 feet long, 19 broad, and the whole depth of the ship; height of top of engine 30 feet above kelson.

Wheels.—The side wheels are 32 feet outside diameter, 10 feet face, effective diameter 30 feet 9 inches.

Two smoke pipes and two ventilators, each 30 inches in diameter, appear above decks in lieu of the usual funnels.

Trials.—The first one was about four hours in duration, the last some $2\frac{3}{4}$ hours. Revolutions obtained, $10\frac{1}{2}$ per minute; pressure of air, 8 pounds per square inch; cut-off at $\frac{2}{3}$ the up-stroke; consumption of fuel, 550 lbs. per hour; kind of fuel, anthracite coal, (the rumor that *charcoal* was used is without foundation;) speed reported, 8 statute miles per hour. This is the element most liable to error. It will hereafter be seen that from reasons which appear to be just, we place her speed at $8\frac{7}{8}$ miles per hour as a maximum. It is quite certain that this latter was not exceeded.

We shall now consider the advantages previously claimed, and premise that in the following comparisons, the Collins steamers are taken as an index of what has been done in steam navigation, and what must be done again in order to ensure passenger traffic across the Atlantic. And further, that the friction of the caloric engine has been estimated as only equalling that of a steam engine, (and the air pump resistance,) whereas it would in all probability be much greater.

Economy of Fuel.—Knowing the consumption on board the *Ericsson*, the first step in a comparison to determine this point is to calculate the size and consumption of steam engines developing the same force. The working cylinder of a caloric engine, as now made, bears to that of a steam engine—

1st. As being single instead of double acting, 2 to 1

2d. As having only $\frac{1}{3}$ of its area effective, owing to that of the supply cylinder being $\frac{2}{3}$, 3 to 1

3d. As using a pressure of 8 pounds,* while in Collins' steamers is obtained 16 pounds cylinder pressure, $12\frac{1}{2}$ vacuum, cutting off at $\frac{1}{3} = 19{\cdot}25$ pounds effective pressure, 2·406 to 1

A proportion equivalent to $(2 \times 3 \times 2{\cdot}406)$ $= 14{\cdot}436$ to 1

Now, the *Ericsson's* working cylinder capacity consists of 4 of 168 inches by 6 feet, having a collective stroke displacement of 3696 cubic feet. Therefore, the steam cylinder must have $\frac{3696}{14{\cdot}436} = 256$ cubic feet capacity, which, cutting off at $\frac{1}{3}$ in two single strokes, gives $\frac{256 \times 2}{3} = 170{\cdot}67 \times 60 \times 10\frac{1}{2}$ revolutions $= 107522$ cubic feet steam per hour, or (at $853 =$ volume of steam at 16 pounds) $= \frac{107522}{853} = 126 \times 64\frac{1}{3} = 8106$ pounds of water per hour, requiring a combustion of $\frac{8106}{7{\cdot}54} = 1075$ pounds per hr. (See page 42, last number of the *Journal.*) That of the *Ericsson* was 550 lbs., or 51 per cent. of the above.

But upon the trials, the leakage of air is stated to have been great, owing to the action of the heat on the lower valves and seats, and to the unequal expansion of the working cylinder during the operation of the engine, its lower diameter having increased one-half inch more than the upper diameter; and as there was not enough elasticity in the piston springs to push out the packing, the leakage at the lower part of the stroke was considerable.†

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* The pressure above the supply piston commences at 0, and only arrives at 8 lbs, at $\frac{1}{3}$ of the up stroke, which is equivalent to cutting it off at $\frac{2}{3}$; the working pressure is 8 lbs., which was cut off at $\frac{2}{3}$-stroke. Hence, the working pressure *effective* was 8 lbs. acting during $\frac{2}{3}$ the stroke $= 7{\cdot}56$ lbs. per square inch on the difference of areas of the working and supply pistons.

† To determine the leakage.

Let the volume of the working cylinder be represented by V
" " " supply " " $\frac{2\,V}{3}$ } then

as the air in the receiver was at a pressure of 8 lbs. the volume $\frac{2\,V}{3}$ at atmospheric pressure, became in the receiver a volume of $\frac{2\,V}{3} \times \frac{15}{15+8} = 0{\cdot}434\ V$, at a pressure of 8 lbs.; and if this were doubled in volume, (involving a heat of something like 493° Fahr.,) which is probably an extreme case, it could follow the piston so as to occupy a capacity of $(0{\cdot}434 \times 2)\ V = 0{\cdot}868\ V$, while it was actually cut off on the trial at $\frac{2}{3}\ V = {\cdot}667\ V$. Hence we may take the whole leakage at $(0{\cdot}868 - 0{\cdot}667)\ V = 20$ per cent.

On the presumption that the temperature to which the air was raised did not exceed that required to double its volume at 60°, this leakage might have amounted to 20 per cent. of the whole working cylinder, or $\frac{\cdot 20}{\cdot 67} = 30$ per cent. of that actually used. Should the *whole* of this be in future overcome, either the pressure would be slightly increased with the same consumption, or the fuel would be reduced, the pressure remaining the same, in the proportion of 1·30 to 1·00, or from 550 to 423 pounds per hour—at which, in this comparison, it will be taken. This would be equal to nearly 40 per cent. of that of a steam engine.

The difference between this amount of fuel (423) and the amount required by calculation (108) to raise the volume of 1,548,240 cubic feet = 120,920 pounds of air 30° the amount not to be returned by the regenerator, is enormous, being nearly 4 to 1; and it is probably owing in part to the radiation from the heated parts, and principally to the imperfect operation of the regenerator.

As to the economy in working, we have no account of the amount of lubricating material to be used in warm cylinders, having nearly 1000 square feet of surface to be kept greased.

Economy of Space.—We have now to consider the second advantage claimed, which is partially estimated on the reduction in amount of fuel for a transatlantic voyage, as occupying more room than that required by the new engine; and begin by a calculation of the power required to drive the *Ericsson* on the ocean at a speed equal to that of the Collins steamers. A few figures will show that to obtain this power in the *Ericsson*, her caloric engines would have to be increased to a size rendering the justice of this claim doubtful.

The Collins steamers will make at the termination of a voyage (in New York harbor), 13½ geographical = 15·55 statute miles per hour, with the steam pressure above taken, and making 17 turns per minute of a wheel 33 feet 3 inches effective diameter. At the same slip, the wheels of the *Ericsson*, making 10½ revolutions of 30¾ feet effective diameter, should have driven her 8·873 miles per hour, which we shall allow as her actual speed. That this speed is inadequate for transatlantic navigation, will be readily seen from the following comparison. (Refer to page 42, present volume, for performance of the *Arctic.*)

Collins steamers make in still water, .	15·55	statute miles per hour.
" " on an average of 3190 hours steaming, a mean speed of . .	13·44	" "
Reduction of speed by weather, &c., . .	2·11	
Speed of the Ericsson in New York Harbor,	8·87	" "
Deduct as above, ...	2·11	
Average speed to be expected, . . .	6·76	" "

The mean of 12 passages between New York and Liverpool, gives as the distance 3080 geographical miles (of 6082⅔ feet,) = 3548 statute miles. At the rate of 6¾ miles per hour, this would require 524 hours = 21 days 20 hours length of passage, which is not less than the average trips of the clipper ships.

To obtain 15·55 miles with the *Ericsson* would require $18\frac{3}{8}$ revolutions per minute. Now the power required to drive a vessel is as the cube of the speed—therefore, to make this latter speed would require $\frac{(15{\cdot}55)^3}{(8{\cdot}873)^3}=5{\cdot}375$ times the power actually developed on the trial. Unless the working pressure were increased, which could not be done without augmenting the area of supply cylinders, and consequent back pressure; or the temperature which would destroy the cylinder bottoms with a rapidity in a far higher ratio than that of the increase of heat; or by cutting off shorter, (thereby slightly augmenting the initial pressure,) which would involve a higher per centage of leakage; the capacity of cylinder developed per minute must be increased 5·375 times, or would have to be $\frac{3696\times10\frac{1}{2}\text{ revs.}}{18{\cdot}375\text{ revs.}}\times5{\cdot}375=11341$ cubic feet, or with the same stroke, (6 feet,) = 1890 square feet collective area, equal to four cylinders 24 feet 6 inches diameter, with supply cylinders 20 feet 2 inches diameter.

The consumption of fuel would be $423\times5\frac{3}{8}=2279$ pounds per hour $=24\frac{3}{8}$ tons per diem.

The same work could be done by two 90 inch × 8 feet cylinders* with the above pressure and revolutions, and the consumption of fuel would be about 5000 pounds an hour = 60 tons a day. The coal saved in a trip of $12\frac{1}{2}$ days would therefore be $35\frac{5}{8}\times12\frac{1}{2}=445$ tons occupying 15,575 cubic feet.

Now a pair of 90's × 8, oscillators, could be very readily put into an area of $30\times15=450$ sq. ft., which by the whole depth of ship is $450\times22\frac{1}{2}$	=10,125	cu. ft.,
and tubular boilers like those of the *Golden Gate*, with fire room between, into an area of $34\times32\times14$ deep	=15,232	"
while the extra coal space required is	15,575	"
Total, . .	40,932	"

Four caloric engines $24\frac{1}{2}\times6$ feet would require an area of *at least* 115 feet in the length of the ship, and 30 feet in width, which by the whole depth (throwing off the projection above deck) $22\frac{1}{2}$ gives $115\times30\times22\frac{1}{2}=77625$, or more than $1\frac{7}{8}$ times the space required for steam engines of equal power.

Safety.—As regards safety, the chances would be decidedly in favor of the new plan. Experience, however, does not show that this advantage, or that of cheapness in passage, (owing to economy of fuel,) is properly appreciated when accompanied by reduced speed; and it is very doubtful whether engines of the size above named *could*, or would be put into a ship of the *Ericsson's* dimensions, in which case her speed would undoubtedly be too slow to ensure popularity.

We have seen, then,

1st, That a saving of fuel of 60 per cent. may be effected.

2d, But that the space required would be 90 per cent. more than that occupied by steam engines, boilers, and the saving of coal. In addition to which it must be recollected that in our comparison, the caloric engines were developing nearly their full power, while the steam engines were cutting off at one-third stroke; consequently, in heavy weather, a very slight increase of pressure on the pistons could be relied on in the former. The capability of following steam the whole stroke in a gale of wind ahead, is of material advantage to ocean steamers.

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* The Steamer *Georgia* is $248\frac{2}{3}$ feet long, 48 feet 8 inches beam, and has two 90 inch cylinders 8 feet, which with a less pressure than we have allowed above, drive the ship at about the same speed as that estimated for.

As to river steamers, the difference of space and weight becomes even greater, as the amount of coal to be carried is trifling.

We think the inference must be drawn from the foregoing, that unless some material change is made in the caloric engine as at present constructed, it is highly improbable that it will ever take the place of steam engines on fast steamers; and as regards freighting vessels, that clippers making average passages of 20 to 25 days across the Atlantic, will probably not be superseded by vessels in which so large a space is taken up by machinery and coal, of which the expenses of running and wear and tear cannot be insignificant, and whose passages will not be averaged in less time.

This inference, however, it must be recollected, does not involve the failure of the object held in view in the construction of the *Ericsson.* That object we presume was to show that by certain peculiarities of construction introduced by Capt. Ericsson, into the engines hitherto used with air, their permanent or continuous operation might be secured, so that the mechanical difficulties (such as heavy losses from friction and leakage, rapid oxydation of metal, &c.,) which have hitherto prevented that class of engines from extended use in practice, might be removed. That question cannot be decided in a few hours; it is the work of time with its usual experience,—and if that experience shall show that the object above alluded to has been accomplished, it is not impossible that *the Caloric Engine* may be extensively employed in pumping or drainage, or in the many branches of manufacture where economy of fuel is the grand consideration, and there is no limit to the space or weight of the machinery to be employed.

In view of these great manufacturing interests to which the benefits of Capt. Ericsson's invention would accrue, it is earnestly to be hoped that time will show the justice of his long continued confidence in his favorite project. M.

For the Journal of the Franklin Institute.

Notes on the United States Steamship Powhatan. By B. F. Isherwood, Chief Engineer, U. S. Navy.

(*With a Plate.*)

The *Powhatan* is a very similar steamship to the *Susquehanna*, an account of whose performance is given in the last October number of this *Journal.* The return of the *Powhatan* from her first few months' cruising, afforded me the opportunity of obtaining her exact performance from the steam log, which I have tabulated for brevity, and in which I have given separately the means for each number of consecutive hours, where the weather, sail, cut-off, &c., remained unchanged. This table contains *all* the steaming done.

The engines of the *Powhatan* and *Susquehanna*, are of the same type, inclined and direct acting; they have cylinders of the same diameter and stroke of piston, and differ from each other in details only. They both cut off by the steam valves, which are of the double puppet kind; Sickels' arrangement for cutting off being used in the *Powhatan*, and Stevens' in the *Susquehanna*.

The hulls of the *Powhatan* and *Susquehanna*, though of the same linear dimensions, have very different water lines. The bow of the *Powhatan* is much sharper than the *Susquehanna's*, while the stern of the latter ship is much finer. The two ends, or rather the fore and after body of the *Powhatan*, are exactly alike, the dead flat being at the centre of the water line, while the model of the *Susquehanna* more nearly resembles that of a sailing vessel, with bow fuller than stern, and dead flat placed forward of the centre of the water line. Both vessels are sparred alike and spread equal amounts of canvass, viz: 21,230 square feet.

HULL.

Length on deck, . . .	251 ft. 6 inches.
Length on water line at 18 feet 6 inches mean draft,	249 " 9 "
Length for Custom House measurement, .	254 "
Length on keel, . . .	246 "
Beam on deck, extreme, . .	45 "
Depth of hold, . . .	26 " 6 "
Height between berth and spar decks in clear of beams,	6 " 9 "
Depth of keel and false keel, . .	1 " 6 "
Mean draft of water at launching, .	10·62 feet.
Actual displacement at launching, . .	1585 tons.
Calculated displacement at launching, .	1600 "
Angle of entrance at 17 feet 6 inches draft, .	48°
Angle of entrance at 19 feet 6 inches draft, .	54° 40′

Displacements and Areas of Immersed Amidship Sections at the following drafts of Water.

Mean drafts of vessel, including keel.	Immersed amidship Sections.	Displacements.
Ft. In.	Sq. Ft.	Tons (2240 lbs.) of sea water.
15 6	528·	2821·
17 2	603·	3249·3
17 6	618·	3335·
18 0	640·5	3467·5
18 6	663·	3600·
19 0	685·5	3732·5
19 6	708·	3865·

At 18 feet 6 inches draft of water, the centre of displacement below water line is 8·86 feet; and the height of the metacentre above the centre of gravity of displacement is 10.87 feet. The position of the centre of displacement is, as has been before stated, exactly at the centre of the water line.

By a comparison of the above with the corresponding items of the *Susquehanna's* hull, it will be seen that at 17 feet 6 inches draft from bottom of keel, the displacement of the *Powhatan* exceeds that of the *Susquehanna* by 58 tons, or about 1·77 per centum of the latter. The immersed amidship section of the *Susquehanna* at the above draft is 21 square feet, or 3·4 per centum greater than the *Powhatan's*. At 19 feet 6 inches draft, the same difference of 21 square feet holds with the immersed amidship section, but the displacement of the *Powhatan now exceeds* that of the *Susquehanna* by 41 tons. At 19 feet 6 inches draft, the *Susquehanna's* displacement per inch of draft is 23 tons, while the *Powhatan's* is $22\frac{1}{12}$ tons. It thus appears the *Susquehanna* has the greater capacity at the load line, while the *Powhatan* has the greater capacity in the lower lines; which also follows from the fact that the centre of displacement in the *Susquehanna* at 18 feet 6 inches draft is 7·167 feet below the water line, while in the *Powhatan*, at the same draft, it is 8·86 feet below the water line, or 1·693 foot lower; also the height of the metacentre above the centre of gravity of the displacement in the *Susquehanna* at 18 feet 6 inches draft is 11·208 feet, while in the *Powhatan* it is 10·87 feet, or 0·338 foot lower.

ENGINES.—Two inclined, direct acting, condensing engines.

Diameter of cylinders,	70 inches.
Stroke of piston,	10 feet.
Diameter of the disks of the steam valves,	14¾ and 16 inches.
Diameter of the disks of the exhaust valves,	15½ and 16¼ "
Space displacement of both pistons per stroke,	534·51 cubic feet.
Steam space between cut-off valve and pistons, at one end of both cylinders,	26. "

PADDLE WHEELS, of the common radial kind.

Diameter from outside to outside of paddles,	31 feet.
Length of paddles,	10 "
Width of paddles,	26 inches,
Area of two paddles,	43⅓ square feet.
Number of paddles in each wheel,	23
Number of paddles in each wheel in water at 18 ft. draft,	5
Immersion of lower edge of paddles at 18 ft. draft of water,	4 feet 11 inches.

BOILERS.—(Plate III.)—Four copper boilers with double return ascending flues.

Length of each boiler,	16 feet.
Breadth of each boiler,	15 " 3 inches.
Height of each boiler, (exclusive of steam chimney,)	13 "
Total area of heating surface in the four boilers,	7706 square feet.
Total area of grate surface in the four boilers,	356 "
Aggregate cross area of the first row of flues in the four boilers,	75·720 "
Aggregate cross area of the second and third row of flues in the four boilers, (each row),	55·906 "
Cross area of the smoke chimney,	63·617 "
Height of the smoke chimney above the grates,	65 feet.
Weight of the four boilers and appurtenances,	199·75 tons.
Weight of sea water in the four boilers, (calculated,)	84·38 "

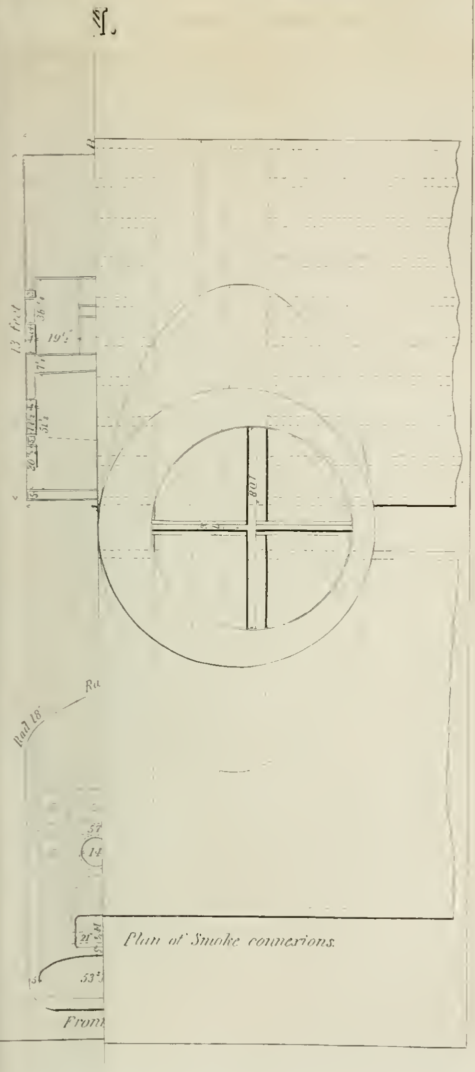
The total length occupied in the vessel by machinery from bulkhead to bulkhead, is the same as in the *Susquehanna*, 102 feet 9 inches; but the bunkers stow only 800 tons of coal, being 100 tons less than the *Susquehanna*, owing to the steam pipes of the *Powhatan*, two in number, being carried through the side bunkers, while in the *Susquehanna* the single steam pipe is carried between the engines.

Table of the Performance of the U. S. Steamship Powhatan, under steam assisted by sail.

DATE, 1852.	Number of consecutive hours.	Speed of the vessel per hour, in knots of 6082⅔ feet.	Course of the Vessel.	WIND.		Sail.	Sea.	Mean draft of vessel.		Immersion of lower edge of paddles.		Slip of the centre of pressure of the paddles in per cents. of its speed.	ENGINES.					Cumberland bituminous coal consumed per h'r.
				Direction.	Kind.								Steam pressure in boiler per square inch above atmos.	Double strokes of piston per minute.	Steam cut off at from commencement of stroke.	Proportion of throttle open.	Back pressure in condenser per gauge.	
								ft.	in.	ft.	in.	per ct.	lbs.		ins.		lbs.	lbs.
Oct. 16 and 17.	17	9·455	S. by W.	N. W. or on quarter.	Mod. breeze	Fore and Aft and mainsail	Smooth.	19	7	6	6	19·48	13·5	12·800	60	3/8	2	4338
Oct 20, 21, 22.	72	10·820	S W.	N. or on quarter.	" "	Top gallant.	"	18	7	5	6	8·73	10 5	12·922	60	5-16	2	4456
Oct 28, 29.	24	10·833	W. by S.	E. S. E. or on quarter.	Light wind.	Topsails.	"	18	2	5	1	5·33	8·6	12·473	60	1/8	2	3300
Oct. 31.	4	11·500	S. W.	N. N. W. or on quarter.	Light breeze	"	"	17	10	4	9	3·94	11·5	13·050	33	1/4	2	3600
Oct 31	9	11·778	S W.	N. W. or on quarter.	" "	"	"	17	10	4	9	6·05	13·3	13·667	50	1/4	2	3000
Oct 31 & Nov. 1	10	6·650	S. W.	N. W. or on quarter.	Gentle br'ze	"	"	17	7	4	6	10·00	13·1	12·900	33	1/4	2	3487
Nov 3.	4	9·750	N. N. E.	E. by S. or abeam.	Fresh wind.	Fore and aft.	Moderate.	17	5	4	4	6·36	10·0	11·350	32	1/4	2	2625
Nov. 3.	20	10·150	N. N E.	" " "	" "	" "	"	17	5	4	4	6·75	9 1	11·865	60	1/4	2	2908
Nov. 4	12	9·417	N N. E	" " "	" "	" "	"	17	3	4	2	3 34	9·8	10·620	40	1/4	2	2800
Nov 4 and 5.	24	10 792	N. by E	S. and E. or on quarter.	" "	Topsails.	Rough.	17	2	4	1	5·75	7·8	12·483	60	1/4	2	2828
Nov. 5	5	10·000	N. by E.	" " "	" "	"	"	17	2	4	1	12·09	11·2	1 ·400	40	1/4	2	2805
Nov. 19, 20.	10	9·250	S. E.	N. E or on quarter.	" "	"	Smooth.	18	5	5	4	2·86	8·5	10·380	60	1/4	2	2490
Nov. 25.	12	10·083	N. W.	S. E. or aft.	Light breeze	"	"	18	1	5	0	27·81	8·5	15·225	60	3/8	2	4400
Means,	223	10 473						18	1	5	0	9·25	10·1	12·600	56	·273	2	3665

Performance under steam unassisted by sail.

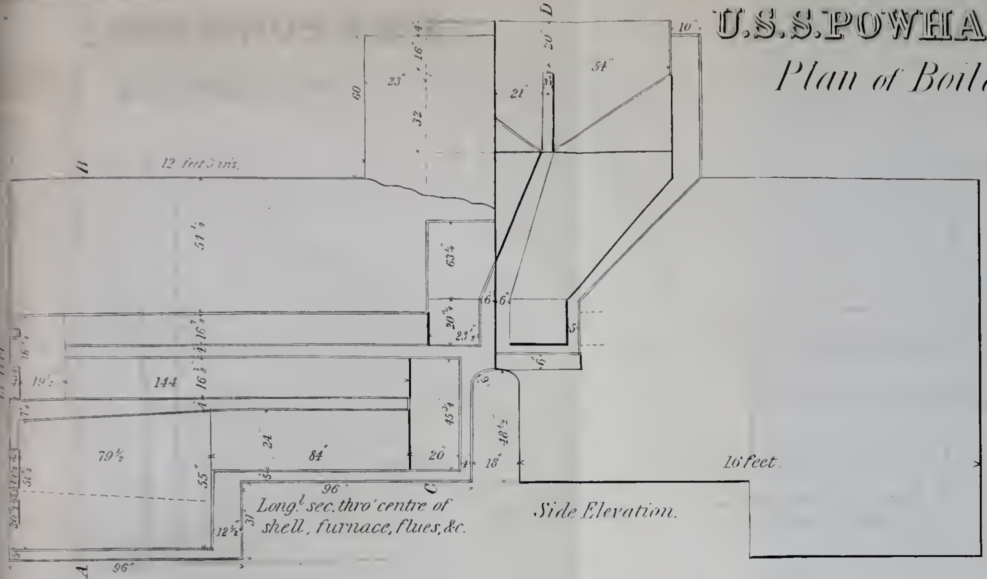
DATE, 1852.	Number of consecutive hours.	Speed of the vessel per hour, in knots of 6082⅔ feet.	Course of the Vessel.	Direction.	Kind.	Sail.	Sea.	ft.	in.	ft.	in.	per ct.	lbs.		ins.		lbs.	lbs.
Oct. 17, 18, 19.	60	9·325	S. W.	S. S. West or on bows.	Light wind.	None.	Smooth.	19	1	6	0	15·59	12 5	12·043	60	5-16	2	4369
Oct. 29.	8	9·625	W. S. W.	S. and W. or on bows.	" "	"	Moderate.	18	1	5	0	10·13	10 0	11·675	60	1/4	2	3300
Oct. 29 and 30.	12	6·917	W. S. W.	S. aod W. or on bow.	" "	"	"	17	11	4	10	14·48	7·4	8·817	20	1/8	2	2390
Oct. 30.	4	8·000	W. S. W.	N. W. or abeam.	" "	"	"	17	11	4	10	26·09	10·0	11·800	60	1/8	2	3340
Oct. 30 and 31	20	9·500	. . .	Abeam.	Mod wind.	"	"	17	10	4	9	6·15	10·0	11·035	50	1/4	2	3583
Nov. 1 and 2.	21	10·452	. . .	On bow.	Gentle bree.	"	Smooth.	17	6	4	5	15·39	9·7	13·467	60	1/4	2	3377
Nov. 6 and 7.	12	8·917	N. N. E.	S. E. or abeam.	Mod. breeze.	"	Moderate.	17	5	4	1	16·40	10·1	11·626	40	1/4	2	2485
Nov. 21 and 22.	24	10·292	S. E.	E. N. E. or abeam.	Fresh wind	"	"	18	2	5	1	16·40	11·6	13·417	60	1/4	2	4424
Nov. 23, 24, 25.	60	10·400	N. E.	N. and E. or on bow.	Light breeze.	"	Smooth.	17	8	4	7	20·70	9·0	14·293	60	3/8	2	4402
Means.	221	9·679						18	1	5	6	16·45	10·4	12·627	56	·292	2	3951



Plan of Smoke connexions.

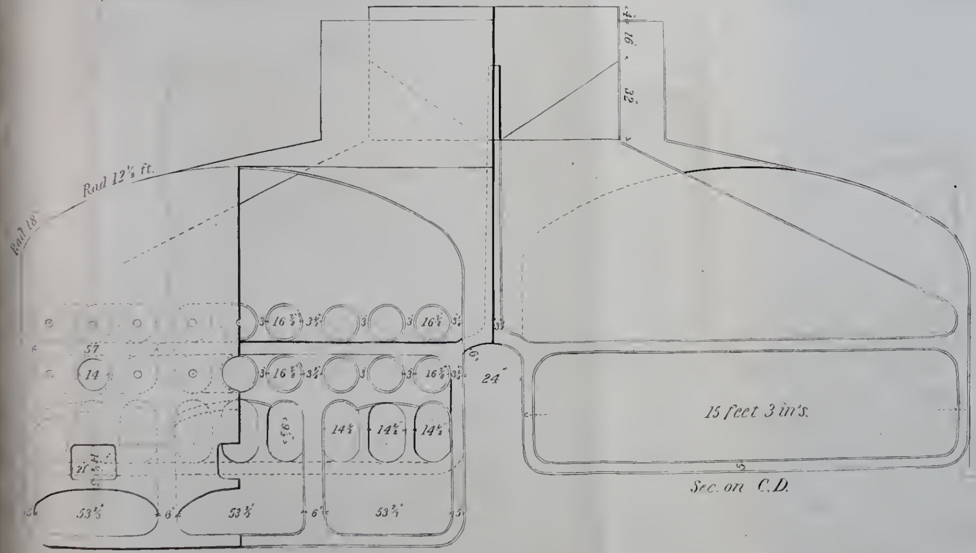
U.S.S. POWHATAN.

Plan of Boilers.



Long.l sec. thro' centre of shell, furnace, flues, &c.

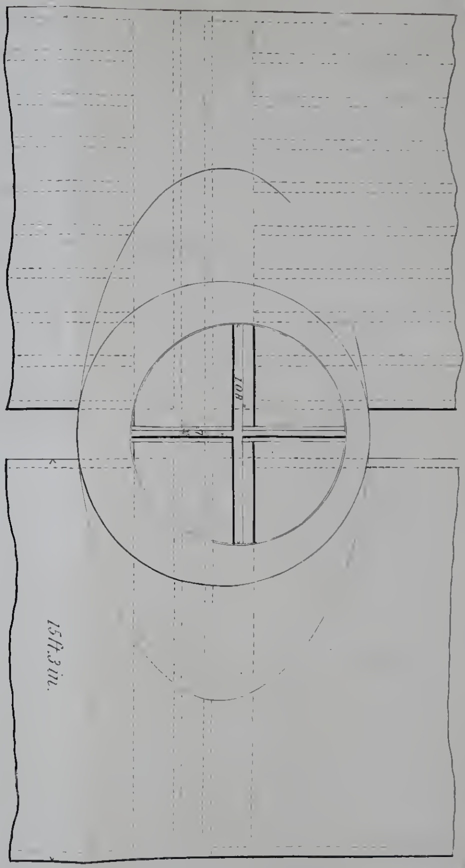
Side Elevation.



Front Elevation.

Sec. on A.B.

Sec. on C.D.



Plan of Smoke connexions.

The mean results from the above log would compare as follows, viz:

nparative performance of the Powhatan, under steam and sail, and under steam alone.

	Assisted by sail.	Unassisted by sail.
Total number of hours,	223	221
Speed of vessel per hour in knots of 6082⅔ feet,	10·474	9·679
Mean draft of vessel,	18 ft 1 in.	18 ft. 1 in.
Immersion of lower edge of paddle,	5 ft	5 ft.
Slip of the centre of pressure of the paddles in per cents. of its speed,	9·25	16.45
Oblique action of the paddle,	18·48	18·48
Steam pressure in boilers per gauge, per square inch above atmosphere in pounds,	10·1	10·4
Steam pressure in cylinders per square inch above atmosphere, in pounds,	6·1	6·4
Double strokes of piston made per minute,	12·600	12·627
Part of stroke of piston, steam cut-off at from commencement in inches,	56	56
Proportion of throttle valve open,	·273	·292
Back pressure in condenser per gauge in pounds,	2	2
Mean effective pressure per square inch of piston in pounds,	13·35	13·6
Horses power developed by the engines,	784·7	801·1
Pounds of Cumberland bituminous coal burned per hour,	3665	3951
Tons of 2240 pounds of Cumberland bituminous coal burned per 24 hours,	39·27	42·33
Pounds of steam evaporated per hour from sea water of twice the natural concentration, by one pound of coal, with the temperature of feed water, 100° F., including the waste by filling the cylinder nozzles and clearance, and by blowing off to maintain the sea water at twice the natural concentration,	6·511	6·135
	Moderate breeze abaft the beam, and moderate sea.	Gentle breeze forward the beam and smooth sea.

Remarks on the preceding Log.

The speed of the vessel (taken by the chip log) comprised in that portion of the table under the head of "performance under steam unassisted by sail," has probably been a little overlogged. This opinion may be arrived at by a comparison of the size of the hull with the size and immersion of the paddles in connexion with their *slip*, the average of which by the log is only 16·45 per centum, whereas it could not have been less than 20 per centum. If the latter slip be taken, the speed of the vessel will be reduced from 9·679 knots to 9·267 knots.

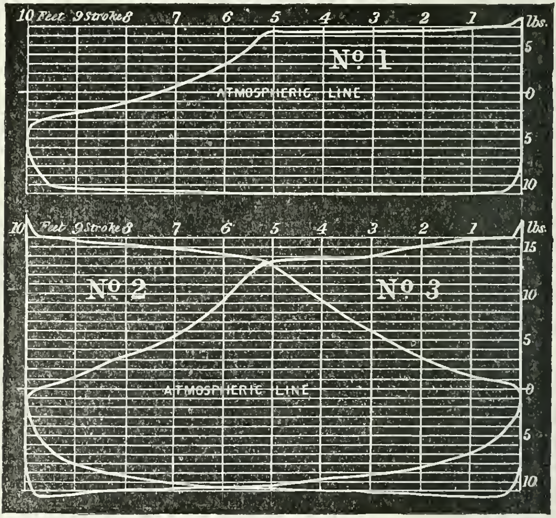
The performance of the engines and boilers may be depended on, the double strokes of piston being taken by a counter, and the point of cutting off ascertained by an indicator applied at both ends of each cylinder. The amount of coal burned is also probably very near the truth; all the furnaces were kept in operation.

The steaming recorded in the preceding log comprises the run from New York to Havana, from Havana to Vera Cruz, from Vera Cruz to Pensacola, and from Pensacola to Norfolk, Va. During the whole time there was fine weather and smooth seas.

The evaporation by the boilers has been calculated from the number of cylinder charges of steam, using the data furnished by Regnault's experiments for the latent heat of steam. The difference in the evaporation in the two cases is nearly 6 per centum of the greater, an amount within the limits of errors of observation, enhanced also by the greater rapidity of the combustion in the case giving the lesser result, as with bituminous coal increased rapidity of combustion is attended with decided effect. The temperature of the engine room appears to have averaged 20° above that of the deck.

Indicator Diagrams.

No. 1 was taken November 25th; steam pressure in boiler per gauge, $7\frac{1}{2}$ pounds per square inch above atmosphere; back pressure in condenser per gauge, $1\frac{1}{4}$ pounds per square inch; temperature of hot well, 100° F., throttle, $\frac{5}{8}$ths open; double stroke of piston per minute, 13.



Nos. 2 and 3 were taken from both ends of the same cylinder, November 20th; steam pressure in boiler per gauge, 21 pounds per square inch above atmosphere; back pressure in condenser per gauge, $1\frac{3}{4}$ pounds per square inch; temperature of hot well, 115° F.; throttle, $\frac{5}{8}$ths open; double strokes of piston per minute, $17\frac{1}{4}$; speed of vessel, $12\frac{1}{2}$ knots per hour by chip log; consumption of Cumberland bituminous coal per hour, 5000 pounds; draft of vessel, 17 feet 10 inches forward, and 18 feet 4 inches aft; immersion of lower edge of paddles, 5 feet; slip of the centre of pressure of the paddles, 21 per centum of its speed. Fresh wind on port bow, moderate sea, and no sail set.

Statistics of the Machinery of the U. S. Steamship Powhatan.

		Weight of materials in a finished state.	Finished surfaces.	Days' labor.	Cost.
		Pounds.	Sq. In.	No. days.	$ cts.
ENGINES, complete, including packing, engine room floor, &c.					
Cast iron,	262,011 lbs.				
Wrought iron,	171,761 "				
Steel,	996 "				
Copper,	8,084 "				
		491,282			
Turning and boring,	545,515 sq. in.				
Planing,	133,757 "				
			679,272		
Finishers,	37,406 days.				
Pattern makers,	2,418 "				
Laborers,	11,268 "				
				51,092	
Total cost,					187,091·84
BOILERS.					
Boiler plates and bolts,	311,895 lbs.				
Brass,	13,082 "				
		324,977			
Total cost,					106,964·50
Boiler appurtenances, viz: smoke chimney, steam, feed, discharge, and escape pipes; feed, check, safety, blow, and stop valves; fire room flooring, grate bars, and bearers; furnace, and flue doors; Worthington pumps, drip pans, &c.					
Cast iron,	57,913 lbs.				
Wrought iron,	22,987 "				
Lead,	2,550 "				
Brass,	17,647 "				
Copper,	21,358 "				
		122,155			
Finishers,	1,647 days.				
Pattern makers,	963 "				
Laborers,	277 "			2,867	
Turning and boring,	40,155 sq. in.				
Planing,	416 "				
			40,571		
Total cost,					28,115·70
COAL BUNKERS, including doors, braces, deck plates, water cocks, &c.					
Cast iron,	2,097 lbs.				
Wrought iron,	114,900 "				
Brass,	275 "				
Copper,	95 "				
		117,367			
Finishers,	118 days.				
Laborers,	23 "				
				141	
Planing and turning,	934 sq. in.		934		
Total cost,					13,984·00
Carried up,		1,056,081	720,777	54,100	336,156·04

		Weight of materials in a finished state.	Finished surfaces.	Days' labor.	Cost.
		Pounds.	Sq. In.	No. days.	$ cts.
Amount brought over, . .		1,056,081	720,777	54,100	336,156·04
Paddle Wheels.—Centres, arms, and rims only.					
Cast iron, . .	21,364 lbs.				
Wrought iron, . .	75,865 "				
		97,499			
Finishers, . . .	173 days.				
Pattern makers, .	116 "				
				289	
Planing, . . .	22,550 sq. in.				
			22,550		
Total cost, . . .					11,858·37
Extra Pieces, engine fixtures, &c.					
Cast iron, . .	27,010 lbs.				
Wrought iron, . .	17,741 "				
Brass, . . .	5,384 "				
		50,135			
Finishers, . .	1,164 days.				
Pattern makers, . .	2 "				
Laborers, . .	170 "				
				1,336	
Turning and boring,	15,273 sq. in.				
Planing, . . .	16,100 "				
			31,573		
Total cost, . . .					13,383·88
Hoisting Engine and Boiler.					
Wrought iron, .	436 lbs.				
Cast iron, . . .	1,435 "				
Brass, . . .	2,310 "				
Copper, . . .	388 "				
		4,569			
Boiler makers, . .	441 days.				
Finishers, . .	30 "				
Pattern makers, .	26 "				
				497	
Turning and boring,	441 sq. in.				
			441		
Total cost, . . .					3,040·78
Pine in all patterns, ...					902·19
		1,208,304	775,141	56,222	365,341·26

For the Journal of the Franklin Institute.

Caloric Ship Ericsson.

Not having had the privilege, alone enjoyed by *reporters* of newspapers and Professor James J. Mapes, in an exhibition of the capacities and performances of this vessel, and entertaining a professional feeling regarding them of the deepest character, I ask the favor of a space in the Journal for a few brief questions, which, if correctly answered, are calculated to afford conclusive elements for an opinion of the actual physical results attained by this novel *arrangement* of a caloric engine, and of its probable utility.

1st. If the fuel expended by the *Ericsson* per hour had been added to that expended per hour by many of the larger class of side wheel steam tugs, would they not have towed her (her immersed buckets and water wheel arms removed) at the highest speed she attained in either of her trials? If not, why not? And if so, wherein is the economy of this caloric engine in fuel?

2d. What is the space occupied by the engines of this vessel, including coal stowage for the average period of five days, and what her speed in knots (sea miles) per hour?

3d. When the space occupied by engines of sufficient power to drive this vessel at a speed of 15 knots per hour, and the coal stowage required for five days, are fully provided for, how much less would it be than that which would be required by a steam engine and boilers capable of effecting the speed of fifteen knots, and with fuel for an equal period?

4th. This vessel being so far completed as to have made two trial trips, and her equipment being such as to enable persons to live on board of her, when is it that she will proceed on her first voyage?

STRAIGHT EDGE.

For the Journal of the Franklin Institute.

The Cunard Steamer Arabia.

This steamship, of which the particulars are published in the present number of this Journal, (vide page 122,) has recently arrived at New York, (Jan. 16th,) on her first trip, in 14 days and 11 hours running time from Liverpool, having passed 20 hours at Halifax, *coaling*. Total time from Liverpool, 15 days 7 hours.

She has been intended by her owners, from the time of laying her keel, to beat the Collins steamers, and no endeavor or expense has been spared to accomplish the purpose. It will be seen by the article referred to, that her length compared to her beam is very great, and that while her register tonnage does not exceed that of the Collins vessels, and her actual capacity is much less, her cylinder capacity is considerably greater, being the largest engine power placed on board any steamer in the world. How the intention, above referred to, has been fulfilled, will be seen when we state that the *Baltic*, which left two or three days before her, (Dec. 29th,) arrived on the 11th inst., in 13 days 3½ hours, *real* time from Liverpool. Difference in favor of the *Baltic*, 1 day 7½ hours running time.

The weather encountered by these two vessels was of course not materially different. If any difference existed it was certainly in the *Arabia's* favor, for before the A.'s departure, the *Baltic* encountered a gale in the channel, which added about 20 hours to her time.

This is the consequence of overpowering a vessel whose model is not adapted to a high rate of speed. While our transatlantic friends were "imitating Brother Jonathan by sharpening the bows," they had better have carried the imitation a little farther, by giving their vessel breadth enough to secure stability and the proper strength. As it is, the ship, from all accounts, is very unsteady, and was strained by attempting to push her through at a high speed, while her consumption of fuel was enormous. She was certainly not sent away from Liverpool on an avowed race with the *Baltic*, without a reasonable supply of coal to carry her to New York; indeed, we are informed by the Liverpool papers that she had 1200 tons on board at her departure. Yet, on arriving off Halifax, she was obliged to put in for more.

When the end held in view in the construction of these ships is remembered, the *La Plata*, (formerly *Arabia*,) and the *Arabia*, (formerly *Persia*,) must be considered failures. The first has been running for some months past on the West India mail line; and neither of them, so far, has made speed which can at all compare with that of the Collins steamers.

For the Journal of the Franklin Institute.

Particulars of the Steamers Building or just Finished in the United States.

We give below particulars of the following steamers now building or just finished in the United States. The list is not as extensive as could be wished, and we trust that manufacturers will forward such information of the engines they are building as is given below, or any other deemed suitable for the *Journal*.

New York.—Steamer *John L. Stevens*, just finished for William H. Aspinwall, Esq., for the California trade. Hull by Smith & Dimon. Machinery by Stillman, Allen & Co.

HULL.—	
Length on deck,	285 feet.
Breadth of beam,	40 "
Depth of hold,	26 "
Tonnage, (Custom House,)	2202 tons.
ENGINE.—Single Oscillating.	
Diameter of cylinder,	85 inches.
Length of stroke,	9 feet.
BOILERS.—Two "drop flue."	
Length,	23 feet.
Breadth,	14 ft. 6 diam.
Depth,	14 " 6 "
Number of furnaces,	6
Length "	7 feet.
Breadth "	4 feet each.
Grate surface,	168 sq. feet.
Total heating surface,	6066 "
Number of flues,	108
Diameter "	13 inches.
Capacity of steam drums,	360 cubic feet.
Number of chimneys,	2
Diameter of chimneys,	5 feet.
Height,	36 feet.
PADDLE WHEELS.—Ordinary Radial.	
Diameter over boards,	32 feet.
Length of "	10 "
Depth of "	20 inches.
Number of "	32

New York.—Steamship *Augusta,* now building for N. York Savannah line. Hull by Wm. H. Webb. Machinery by Stillman, Allen & Co.

HULL.—

Length on deck,	220 feet.
Breadth of beam,	35 “
Depth of hold,	22 “
Tonnage (Custom House,)	1283

ENGINE.—Single Oscillating.

Diameter of cylinder,	85 inches.
Length of stroke,	8 feet.

BOILERS.—Two “rising flue.”

Length,	28 “
Breadth,	11 feet diam.
Depth,	11 “
Number of furnaces,	6
Length “	7 feet 6 in.
Breadth “	3 “ 10
Grate surface,	172½ sq. feet.
Total heating surface,	5200 “
Number of flues,	52
Diameters “	13, 14, 16, 17, 18 inches.
Capacity of steam drums,	390 cubic feet.
Number of chimneys,	1
Diameter, “	6 feet.
Height, “	36 “

PADDLE WHEELS.—Ordinary radial.

Diameter over boards,	30 feet.
Length of “	10 “
Depth of “	20 inches.
Number of “	32

Philadelphia.—Steamship *Keystone State,* for Philada. and Savannah line. Building. Hull by Vaughn & Lynn. Machinery by Merrick & Son.

HULL.—

Length on deck,	220 feet.
Breadth of beam,	35 “
Depth of hold,	21 “
Tonnage, (Custom House,)	1283 tons.
Length of engine and boiler space,	58 feet.
Draft when loaded, (to be,)	12 “
Contents of Bunkers,	160 tons.

ENGINE.—Single Side Lever.

Diameter of cylinder,	80 inches.
Length of stroke,	8 feet.
Steam pressure, (intended,)	22 lbs.
Cut-off,	variable.

BOILERS.—Two, return tubular, same as *State of Georgia.* (See Journal, xxiii. 409.)

Length of each over all,		16 feet.
Breadth,		12 feet 8 in.
Height, (except drum,)		11 feet 1 in.
“ of drum,		12 “
Steam contents of both drums,	416	
“ “ of shells above water level, 12 in. over tubes,	846	
		1262 cubic feet.
Number of furnaces,		8
Width,		2 feet 7 in.
Length,		8 feet.
Grate surface,		166 sq. feet.
Heating “ in tubes, (inside,)	4489	
“ “ furnaces, connexions, &c.,	1106	
		5595 “

Number of tubes,	480
Diameter of " (inside,)	3¼ inches.
Length of "	11 feet.
Diameter of chimney,	6 "
Height of "	35 "

PADDLE WHEELS.—

Diameter over boards,	30 "
Length of "	9 feet 9 in.
Depth of "	1 foot 8 in.
Number of "	28

Philadelphia.—Steamer *Carolina*, (destination not given.) Hull b Wm. Cramp. Machinery by Reany, Neafie & Co.

HULL.—

Length on deck,	180 feet.
Breadth of beam,	30 "
Depth of hold,	8 "
Contents of bunkers,	20 tons.

ENGINES.—Two upright cylinder, geared to the propeller shaft, in the

ratio of	1 to 2½
Diameter of cylinders,	40 inches.
Length of stroke,	3 feet.
Steam pressure,	20 lb per sq in
Cut-off at	½ stroke.

BOILERS.—Two "flue and rising return flue."

Length, each,		21 ft. 3 ins.
Breadth of furnace front,		8 feet.
" cylindrical shell,		7 " diam.
Height, (except drums,)		7 " 6 ins.
Steam contents in both,	280	
" " in shell above water level 9 in. above flues,	320	
	——	600 cubic feet.
Number of furnaces, (in both,)		4
Breadth of "		3 feet 4
Length of "		5 " 3
Grate surface, (in both,)		68¼ sq. fecet.
Heating " "		1700 sq. feet.
Number of flues, "		28
Length,		16 feet.
Diameter of flues, (inside,)		7 inches.
" of chimney,		5 feet.
Height of "		40 "
Weight of boilers filled,		40 "

PROPELLER.—

Diameter,	8 feet 3 in.
Length,	5 " 9 "
Pitch at periphery,	15 " 3 "
Number of blades,	4

Philadelphia.—Four coasting steamers now building, (names and destinations unknown.) Hulls, by Byerly & Son. Machinery by Reany, Neafie & Co.

HULL.—

Length on deck,	160 feet.
Breadth of beam,	24 "
Depth of hold,	11 "
Tonnage, (Custom House,)	435 tons.

ENGINE.—One direct action vertical cylinder, non-condensing.	
Diameter of cylinder,	28 inches.
Length of stroke,	2 feet 4 in.
Steam pressure,	60 lbs.
Cut-off,	½ stroke.
BOILER.—One "flue and rising return flue."	
Length,	21 feet.
Breadth, shell cylindrical,	6 "
Height, except drum,	6 " 6
Steam contents, drum and shell,	180 cubic feet.
Number of furnaces,	1
Breadth "	5 feet 3
Length, "	4 " 9
Grate surface,	25 sq. feet.
Heating "	625 " "
Number of flues,	14
Diameter " (inside)	6 in.
Length of "	16 feet.
Diameter of chimney,	2 " 3
Height of "	25
Weight of boiler filled,	14 tons.
PROPELLER.—	
Diameter,	8 feet.
Length,	5 " 6 in.
Pitch at periphery,	22 " 6 in.
Number of blades,	4

Photography:—The Fixation of Colors.[*]

M. Niepec de Saint-Victor laid before the Academy of Sciences, at the sitting of the 8th of November, daguerreotypes upon which he had succeeded in fixing, in a manner more or less permanent, colors by the camera-obscura. M. Niepec states, that the production of all the colors is practicable, and he is actively engaged in endeavoring to arrive at a convenient method of preparing the plates. "I have begun," he says, "by reproducing in the dark chamber, colored engravings, then artificial and natural flowers, and lastly, dead nature—a doll, dressed in stuffs of different colors, and always with gold and silver lace. I have obtained all the colors; and, what is still more extraordinary and more curious is, that the gold and silver are depicted with their metallic lustre, and that rock-crystal, alabaster, and porcelain, are represented with the lustre which is natural to them. In producing the images of precious stones and of glass we observe a curious peculiarity. We have placed before the lens a deep green, which has given a yellow image instead of a green one; whilst a clear green glass placed by the side of the other is perfectly reproduced in color." The greatest difficulty is that of obtaining many colors at a time; it is, however, possible, and M. Niepec has frequently obtained this result. He has observed, that bright colors are produced much more vividly and much quicker than dark colors:—that is to say, that the nearer the colors approach to white the more easily are they produced, and the more closely they approach to black the greater is the difficulty of reproducing them. Of all others the most difficult to be obtained is the deep green of leaves; the light green leaves are, however, reproduced very easily. After sundry other remarks, of no peculiar moment, M. Niepec de Saint-Victor informs us, that colors are rendered very much more vivid by the action of ammonia, and at the same time this volatile alkali appears to fix the colors with much permanence. These results bring much more near than hitherto the desideratum of producing photographs in their natural colors. The results are produced upon plates of silver which have been acted upon by chloride of copper or some other combination of chlorine. The manipulatory details have not been published, but we understand they are very easy.

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[*] From the London Athenæum, November, 1852.

For the Journal of the Franklin Institute.

Remarks on Incrustation in the Boilers of the Steamship Isabel.

A few weeks since the steamship *Isabel* came into this port for repairs of hull and machinery, and to replace her boilers. The boilers have been removed, and are now being cut up; an opportunity has thus been afforded to obtain the accompanying specimen of scale from her boilers, which, in the opinion of the writer, show an extraordinary degree of ignorance or negligence on the part of those persons having charge of her machinery.

If we are not mistaken, this vessel commenced her service in the winter of 1848, and the boilers have therefore been in use three and a half years; the ship plying semi-monthly between Charleston, Havana, and Key West: she is under steam an average of sixteen days per month, for ten months in the year; consequently, the boilers are now to be replaced after about six hundred days' service. The vessel being laid up for two months in each year for a general overhaul and repairs, it is to be supposed that *at such times at least* the scale is removed; in fact, the number of lamina in one of the pieces forwarded agrees with this supposition: therefore, this accumulation, estimated to amount to about a ton, has been deposited in less than a year.

It is commonly asserted, to exculpate careless engineers, that the water in the vicinity of coral reefs holds in suspension, in addition to the usual constituents of sea water, a quantity of carbonate and sulphate of lime. I am not aware that this assertion has been proved by an analysis of the water; but an experience of four years on board steamships in the Gulf of Mexico, satisfies me that no accumulation of scale to exceed one-sixteenth of an inch need be made.

These boilers have common return flues, and there could have been no difficulty in cleaning them, if inadvertently in a careless moment a small deposition had been made; but, unfortunately, many engineers confine their attention to the interior of the furnaces and flues, to the neglect of the interior of the boiler.

The scale averaged three-eighths of an inch thick over the shell, and upwards of half an inch on the flues and connexions; in some places not less than four inches thick: the greatest deposit in the vicinity of the back connexions, where it hung pendant like stalactites.

There can be, I think, no doubt but that this extraordinary accumulation was caused by neglecting to blow, and carrying the water at a density approaching saturation. The loss occasioned by this neglect, independent of that caused by the short term of duration of the boilers, cannot be estimated at less than fifty per cent. in fuel; and we can only attribute their exemption from collapse to the thorough manner in which they are braced, and to the fact that the engines were short of steam, and worked it off with such rapidity as to keep the pressure below the point necessary to collapse red hot flues.

Specimen No. 1. Taken from over the furnace; iron in contact with it much injured, and showing evident marks of having been overheated; half an inch in thickness.

No. 2. Taken from an angle of the furnace, at the entrance of the flues; this specimen is completely vitrified; five-eighths thick.

No. 3. Taken from the vertical portion of the shell adjacent to the furnace. This specimen has not been in contact with red hot iron, and presents an entirely different fracture and appearance; five-eighths in thickness.

No. 4. Taken off a flue at the back connexions; presents a crystalline fracture, and marks of having been subjected to great heat; one inch and a quarter in thickness. N.

Baltimore, Md., August 20th, 1852.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 20, 1852.

Samuel V. Merrick, President, in the chair.

Thomas Fletcher, Vice President.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from the Royal Astronomical Society, London, Dr. David Dale Owen, U. S. Geologist; The Ohio Mechanics' Institute, Cincinnati, Ohio; T. H. Forsyth, Senate of Pennsylvania; The Legislature of Pennsylvania; Charles Ellet, jr., Esq., Theophilus Code, Esq., and Dr. C. M. Wetherill, Philadelphia.

Donations to the Cabinets from Wm. N. Jeffers, Esq., U. S. Navy, Professors J. C. Cresson and J. H. Alexander, U. S. Commissioners to examine steam boilers, and J. V. Merrick, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of December; also, his annual statement of the Funds of the Institute.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Publications reported their annual statement of the condition of the Journal of the Institute.

The Committee on Exhibitions presented a special report, recommending the following preamble and resolution:

Whereas, The following gentlemen have with great liberality subscribed a sufficient amount to allow the Franklin Institute to publish five thousand copies of their report of the twenty-second Exhibition of American Manufactures, to be distributed gratuitously:

Therefore, be it *Resolved*, That
John Tucker, Esq., President of the Reading Railroad Company,
Edgar J. Thompson, Esq., Pres't. of the Penn'a " "
Christoper Fallon, Esq., " " Sunbury " "
Wm. H. Gatzmer, Esq., Sec'y. Camden and Amboy " "
David S. Brown, Esq.,
P. S. Duval, Esq.,
are deserving of the thanks of the Franklin Institute, and of all those who desire the promotion of the mechanic arts.

Resolved, That the Committee send a copy of the above report, with the resolutions attached, to each of the gentlemen named.

The Special Committees reported progress.

New candidates for membership in the Institute (6) were proposed, and the candidates (5) proposed at the last meeting were duly elected.

The Tellers of the annual election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen as duly elected:

Samuel V. Merrick, President.
Thomas Fletcher, } Vice Presidents.
Abraham Miller, }
Isaac B. Garrigues, Recording Secretary.
Solomon W. Roberts, Corresponding Secretary.
John F. Frazer, Treasurer.

MANAGERS.

Matthias W. Baldwin,
Frederick Fraley,
John Agnew,
John Wiegand,
John C. Cresson,
John H. Towne,
Edwin Greble,
David S. Brown,
Owen Evans,
Alan Wood,
Asa Whitney,
Isaac S. Williams,
H. P. M. Birkinbine,
Geo. W. Conarroe,
Thos. J. Weygandt,
Joseph J. Barras,
Geo. N. Eckert,
Charles E. Smith,
John C. Trautwine,
Wm. D. Parrish,
Frederick Graff,
Thos. S. Stewart,
John E. Addicks,
John M'Clure.

AUDITORS.

Algernon S. Roberts,
Samuel Mason,
James H. Cresson.

Mr. J. V. Merrick exhibited a portion of the wire of the submarine telegraph, laid between Dover and Calais. It consists of four copper wires, imbedded in gutta percha, outside of which were arranged a series of strong rods of galvanized iron.

Mr. ———————— exhibited a model of a new plan for propelling vessels.

Mr. William Stott exhibited a dioramic shade for ordinary lamps, manufactured by himself. This shade has upon it landscapes, which are changed when it is placed over the lamp.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MARCH, 1853.

CIVIL ENGINEERING.

Railway Accidents; their Cause, and Means of Prevention. By Captain Mark Huish, Assoc. Inst. C. E. Edited by Charles Manby, M. Inst. C. E., Secretary.*

Continued from page 103.

Allusion has now been made to those points connected with the road, and the machinery employed upon it, from which loss of life and injury to person and property most generally arise. The whole of these causes, however, do not produce a tithe of the accidents which result from inattention to signals, and the neglect of regulations. Of all sources of danger on a railway, these are the most prolific. Human agency is necessarily imperfect, and it cannot be expected that the servants of a railway Company, however carefully selected and diligently tutored, will be exempt from such a general law. The effects of a momentary forgetfulness, or an instant's neglect, are frequently fraught with tremendous consequences, and the miscalculation of a few yards may produce the most lamentable results. There is, therefore, no part of the system to which the railway manager looks with more anxiety, than to the efficiency of the signals on the line. If these are either defective, or too limited in number, the casualty which will probably result, must be attributed to the carelessness which has overlooked the danger, or to the injudicious economy which has permitted it. Railway stationary signals have within a few years been greatly improved. The introduction of the lofty semaphore has left little to be desired in this respect, while the further use of the auxiliary signal has completed this most necessary adjunct to safe working. The distance at which these signals should be planted, must depend on the nature of the ground, and the character of the gradient. Generally speaking, with the prevailing high speeds and heavy trains, the extended arm of an auxiliary signal should be seen at a distance of from 800 to 1500 yards. The space within which a train can be pulled up varies very much, according to the state of the weather, as well as to the tenacity of the brakes, the speed, the inclination of the road, and the weight of the load; but for practical purposes, the distance named above will be found to answer, and less than this should not be accepted, where circumstances permit its being obtained. Not only is the positive safety of the train secured by such a signal, but the nerve and the steadiness of the engine driver is supported by the feeling that the means of protection are provided for him. Care should be taken to fix the signal, so that no distant object may interfere with the free sight of it, and as the speed, weight, and number of trains on the line increase, opportunity should be taken periodically to revise the distances, to ascertain that every doubtful point is covered, and that nothing which may be provided against by caution, is left to contingency. Some difference has existed among railway managers, as to the mode of dealing with signals, at junctions with branch lines. It has, however, been gradually ruled, that the safest course is to keep the danger, or stop signal, fixed against the branch, so that no train may be allowed to enter on the main line until such signal be removed. The safety of the trains moving between stations, and temporarily impeded, from any cause, depends on the attention paid by the guards to the regulation, to proceed back a certain distance with the hand signal. This distance varies from 500 to 800 yards, according to the rules of different Companies. Probably the latter is too far, unless the distance terminates in a curve, as a hand signal may be seen under ordinary circumstaces, from 300 to 500 yards further. Nothing is more difficult, however, than to secure strict obedience to this rule, and the most particular attention should attach to any breach of it. Upon it hinges the safety of the train, and the fact of no accident happening, should not be a bar to the most severe punishment of the offending party. A careful guard will also be guided by the state of the rails and the atmosphere: if the former are what is termed "greasy," or the latter is heavy, a longer distance than ordinary is evidently required to protect the train. Until recently no special means exist of securing a train against collision during a fog. The detonating signal supplied this deficiency, and has become one of the most useful protections which the railway manager possesses. Its use, therefore, is universal, as in a humid climate like that of England, it was absolutely necessary to complete the code of signals. During a recent dense fog which lasted two days, and was so thick as to render objects invisible at a distance of a few yards, the London and North Western Railway was necessarily worked entirely by the detonating signals. The experiment was successful, and although irregularities were very frequent, no accident occurred, although nearly 400 trains ran during that anxious time.

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* Proc. Inst. Civ. Eng., April 27th, 1852.—London Railway Journal, No. 700.

Great weigh is generally attached to the question of regularity in the times of the trains, as an essential element in their safety, and whenever an accident occurs the press and public opinion, as expressed through a jury, seize on this point as the primary cause of the mishap. The author would by no means undervalue the importance of punctuality, and as rigid an adherence as possible to the published time-tables, but it may be doubted whether undue stress has not been attached to it. Under a well regulated system of signals, and with a well disciplined staff, the greatest irregularity, whatever inconvenience it may produce, ought not to lead to danger. To a certain extent the very uncertainty of the passage of trains produces safety, by the continual vigilance it necessitates, and as few accidents occur in the most busy thoroughfare of London, so the most crowded parts of a railway exhibit the greatest freedom from casualty.

It is fortunate, indeed, that the public safety is not necessarily linked with punctuality, for the extension of the system, and the connexion with cross lines, by coaches and steamboats, is daily importing into the long trains fresh chances of delay. The mail train of the London and North Western Company starts from Dublin on the west, and Aberdeen on the north; during its passage it connects with a great number of railways, the irregularities of each and all of which become multiplied as the train advances. When, therefore, it reaches the London and North Western line, it has probably missed its appointed turn; it consequently becomes an exceptional train during its entire transit, yet none is better protected, or passes along the line with greater safety. The facility of working a trunk railway, with a heavy traffic, under the variations alluded to, has, however, been greatly promoted by the introduction and extensive use of the electric telegraph. Just as the demands on the railway system were beginning to outgrow its existing machinery for safety, this remarkable power came to its aid, and extended its capacity in an incalculable degree. The effect cannot be better illustrated than by a reference to its operation on the London and North Western Railway during the great Exhibition. Prior to the opening the Directors had been much pressed by the Royal Commissioners, for greatly reduced fares, to afford all classes of the community an opportunity of participating in an enjoyment which could not be expected to recur. The result is well known. The most distant parts of the kingdom poured their population into London, and the aggregate number exceeded expectation. In addition to the passengers by the ordinary trains on the railway, which were very largely increased, 775,000 persons were conveyed to and from London by the excursion trains, for whose conveyance 24,000 extra carriages passed through the Euston Station. The receipts of the railway rose to £70,000 in a single week. That such an extraordinary traffic centering in a single focus, arriving at irregular hours, and in almost unlimited numbers from more than thirty railways, should have been carried on for six continuous months without the most trifling casualty, or without interruption to the very extensive business in merchandise, coals, and cattle, continually moving on the line, and with a remarkable punctuality (looking to the contingencies arising from the irregularities of neighboring lines), is due, not more to the discipline and good conduct of all the servants, than to the power of regulation which a liberal use of the telegraph placed at their disposal.

The author, who had the charge of the whole arrangements, foresaw the impossibility of reliance being placed on ordinary measures to govern so irregular a traffic. From the very great distance many of these trains had to traverse before reaching the North Western Railway, dependent in many cases, also, on steamboats, and the delay incident on overloaded trains, it was impossible to rely on any time bill framed by the forwarding Company, while the number of these excursion trains, flowing from every quarter, and amounting sometimes to between twenty and thirty a day (many of them not known to be *en route* till they reached some one or other of the termini of the line), rendered it impossible to fix any specific time for their transit. The attempt would have so clogged and impeded the service as to have introduced the greatest irregularity into every department. Under these circumstances the following plan was adopted, and continued with success throughout the whole period of the Exhibition. The running speed of all excursion trains was fixed with reference to their weight, and a general rule in accordance was issued. Instant notice was given by telegraph of the arrival at and the departure of each train from every terminus, and this information being re-transmitted to every important station, and repeated as the train passed in both directions, a time bill was immediately constructed, according to the prescribed table of speeds, from which correct information was obtained and acted on with promptness and precision, and thus, instead of dependence being placed on theoretical time bills, which in the majority of cases would have created difficulty and confusion, the telegraph, by tracing every train through its entire journey, became a practical instrument of safety of infinitely greater value. On every long line of railway the first class stations are rarely more than twenty miles apart. It is evident, therefore, that by the establishment of telegraphic instruments at these distances, the railway becomes a system of detached and corrective links, and the irregularities inseparable from the system are modified and adjusted. Some years ago a strong impression prevailed in high quarters, that the trunk line of the London and North Western Railway was overloaded with traffic, and relief lines were talked of as a consequent necessity. By the improvements since introduced, and by the assistance which science has thus placed at the disposal of that Company, the traffic has been double in quantity, and there is at this moment a greater capacity for increasing it further, than at any previous period of its history. The value of the telegraph, for the working of tunnels, and the absolute protection from collision which is thus afforded, cannot be overrated.

The length to which these remarks have extended, renders it necessary to be very brief in alluding to other and less important causes of accident.

Defective brakes and fractures of couplings on steep inclines, have not unfrequently led to accident, yet the working of the Lickey incline is evidence of the safety of the system, if only ordinary care and caution are exercised. More than one accident has arisen from trees falling across the rails. Care should, therefore, be taken to remove all that are likely to be affected by storms, or by the slipping of the ground. Trains have occasionally been thrown off the rails by cattle jumping out in transit, and some very narrow escapes have occurred in consequence. Level crossings are also a fruitful source of danger if they are not very carefully watched. A sad catalogue of deaths at these crossings will be found in the parliamentary returns, and their increasing number indicates the necessity for greater vigilance, or a change of practice. Lastly, reference must be made to the tendency of Parliament, in recent sessions, to extend what are termed "running powers." It is to be greatly feared, that if this system is permitted to extend, a new element of the greatest danger will be introduced, the effect of which it is at present scarcely possible to calculate. If, with the whole energies of a concentrated establishment, under well known rules and discipline, danger cannot be avoided, what must be expected from strange and rival executives using the same line of rails, and unacquainted with its peculiarities?

The regulations of most Companies have now a very general similarity of principle, modified by the circumstances of each line. These rules are constantly undergoing improvement, and any fresh cause of danger is provided for, as it develops itself. Accidents, however, very rarely happen from foreseen circumstances. They are generally of a compound character, and result from the simultaneous conjunction of several causes. It is easy to be wise after the event, but so long as machinery is material, and human nature is fallible, it is to be feared, that although experience and skill may diminish, they will not prevent the recurrence of events that startle society, and cast blame on railway management. The rapid glance which has been thrown on the more salient points of danger, show the variety of causes from which it may at any moment arise. The increasing nature of the transit renders such casualties possible at any moment. In the year 1851, during which 7,900,000 passengers (nearly one-third of the population of England) traveled on the London and North Western Railway, only one individual met his death—yet this casualty, from which the author also suffered, was the effect of the gravest disobedience of orders. The exception proves the rule, and it is due to the engine drivers and guards of Great Britain, to state, that there is probably no class of men, to whom such serious duties are intrusted, and who repay with such fidelity, attention, and skill, the confidence reposed in them. Kind and considerate treatment, and good wages, combined with the utmost strictness of discipline,—a readiness to reward merit, and a rigid determination to punish severely any dereliction of duty, are the best means of forming good and attentive servants. Inebriety should never, under any circumstances, be overlooked, or pardoned, whatever claims the offender may otherwise possess in regard to general efficiency, or length of service. A system of regular promotion, wherever it can be applied, is perhaps the greatest stimulus to good conduct; and experience has clearly shown, that, in general, better results have been obtained by rewarding obedience, than by the greatest severity in punishing misconduct. The habits of order and regularity which are thus generated, extend beyond their immediate sphere, and react on society at large. As an instrument for advancing the social position of the country, the railway system, with all its admitted defects, exercises no light influence, and although the benefits are not unmixed with evil, the advantages are purchased at a less cost of personal suffering and sacrifice, than (looking at the conditions under which they are obtained) might reasonably be expected.

Report of Edward Miller, Esq., Ch. Eng., upon the Western Connexions and Extensions of the Pennsylvania Railroad.

J. Edgar Thomson, Esq., Pres. Penn. Railroad Co.

Sir:—In accordance with the instructions of the Board of Directors, I have endeavored to procure the most accurate information concerning the different extensions of the Pennsylvania Railroad westward; and have verified it by personal examination of the maps, profiles, and estimates of the respective companies, where I was able to do so. I cannot, however, pretend to have done this universally, nor to have passed over the numerous lines of railroads in Ohio, having a bearing on this subject. The Board are fully aware that to have done so with a view of examining these lines professionally, would have required more time than it has been possible to spare from my pressing and immediate duties upon the Pennsylvania Railroad.

Boston, New York, Philadelphia, and Baltimore, are now striving to obtain the trade of the West; and all these cities have constructed railroads for the purpose. New York alone possesses two of these avenues, one by the Hudson River and Albany and Buffalo Railroads, and the other the New York and Erie. The Albany and Buffalo line, together with the Western and Worcester roads of Massachusetts, form the Boston route. Philadelphia has constructed her road to Pittsburg, and Baltimore her own to Wheeling. The latter city is also engaged in the construction of the Parkersburg branch, of which the present road to Wheeling will form the main stem as far as Three Forks. The topographical features of the country appear to forbid the construction of any great leading line within the limits of the United States, independent of these, and within their range, with one exception, the Sunbury and Erie Railroad.

It is not unusual to speak of the West as if it were practicable to divert its entire trade to a single city by a single railroad. It is, however, a great commercial reservoir, which even now is able to fill all the channels constructed to carry off its surplus, and which will require all of them soon to be increased in capacity and stretched to their utmost limits, to carry away its treasures as rapidly as they accumulate. The enterprise of our western neighbors, the aid they have received from eastern capital, and the facilities of construction, are rapidly covering Ohio, Indiana, Illinois, Kentucky, and Southern Michigan, with a net-work of railroads, which appear on the map at first view as a confused mass of competing and interfering lines. Some of these will prove failures, and others projected as leading lines will sink into the position of branches and feeders to those better placed and supported. But it is certain that the keen competition produced by their number, and the remarkable facilities afforded by them, will stimulate agricultural productions to the utmost; and that those lines which become either by intrinsic merit or adaptation, the leading thoroughfares, will be very profitable. A close investigation of the map will show that various causes have concentrated upon certain points several railroads, which appear to radiate from these places in different directions. The principal of these are Pittsburg, Wheeling, Cleveland, Cincinnati, St. Louis, Chicago, Columbus, and Indianapolis. Of these, nature and art have combined to make Pittsburg, Cleveland, Cincinnati, Chicago, and St. Louis, great centres of trade; and divergent lines are now in progress, or completed, which will connect Philadelphia by direct routes with all these places, and also with Lexington, the central point of Eastern Kentucky. Western Kentucky will be best reached through Cincinnati.

It is not my intention to enter into a discussion of the relative merits of the different seaboard cities, or of their lines of communication with the interior, being satisfied that all these cities will reap the rich harvest of their laudable enterprise, and that all these avenues will find full and profitable employment. In a commercial point of view, however, there can be no doubt that the interests of Philadelphia require her to be connected by ties of sympathy with those railroads which will afford the best and most direct communication with the important points just named; and that she should not be wholly dependent for any portion of her trade upon such routes as pass through rival cities, or are subjected to their caprice, influence, and interference.

Taking the leading routes which may be considered as dependent mainly upon Philadelphia, and commencing at the north, we have the Ohio and Pennsylvania Railroad, now upon the point of completion, which commences at Pittsburg, the western terminus of the Pennsylvania Railroad, and passing through the great wheat belt of Ohio, by way of the important towns of Salem, Canton, Massillon, Wooster, and Mansfield, terminating at Crestline on the Cleveland and Columbus Railroad. It is crossed by lines running west of north to Cleveland and Sandusky, which are completed, and is extended by the Ohio and Indiana road to Fort Wayne, on the direct route to Chicago; and by the Bellefontaine and Indiana roads to Indianapolis and Terre Haute, on the way to St. Louis.

On the south it is now connected by the way of Columbus with Cincinnati, and will soon have a more direct communication with that city by the Mount Vernon road to Springfield.

These lines, the construction of which is now rendered secure by the aid and countenance of the Pennsylvania Railroad Company to the Ohio and Pennsylvania, Ohio and Indiana, and Mount Vernon roads, will give access to a country of immense production, by routes sufficiently favorable to afford a vast advantage to the Pennsylvania Railroad even for that trade which seeks New York as its market.

Of the propriety of granting this aid, and of the beneficial results which must follow it, I do not entertain a doubt; the full advantage, however, will not be realized, until by a branch line and bridge over the Allegheny river the two roads are brought side by side, and the present charges for drayage abolished, which operate as a tax in favor of New York and Baltimore. The gauge of these lines is four feet ten inches.

The next line to be considered commences also at Pittsburg, and passes through Steubenville and Coshocton to Newark, where it connects with the Central Ohio road to Columbus. It is intended hereafter to extend it by an independent line to that point, where it will join the Columbus, Piqua, and Indiana road. All these roads have the Pennsylvania gauge of four feet eight and a half inches, and will connect us with the Indiana roads of the same gauge, which will thus be unbroken from Philadelphia to St. Louis, on a very direct and feasible route.

The Pittsburg and Steubenville Company have not yet succeeded in obtaining the right of constructing their road through the narrow neck of Virginia, but hope to do so this winter. After obtaining this, should they need aid, they will possess strong claims upon Philadelphia for assistance. The gradients upon this line correspond with those of the Western Division of the Pennsylvania Railroad.

The next line which requires attention is the Hempfield Railroad, commencing at Greensburg, thirty-one miles east of Pittsburg, and extending through Washington to Wheeling. From this point two roads diverge; the central Ohio road through Zanesville and Newark to Columbus; and the Marietta and Cincinnati road through Marietta and Chilicothe to Cincinnati. The first is completed from Zanesville to Columbus.

The Central Ohio road, at Zanesville, intersects the Wilmington road, passing through Lancaster, Circleville, Washington, and Wilmington, to the Little Miami road, by which it is connected with Cincinnati. This is the shortest line from Philadelphia to Cincinnati, but its gradients are less favorable than those of the Ohio and Pennsylvania, Steubenville, and Marietta lines. Its projectors have hitherto looked towards Baltimore for assistance and sympathy, but it will be an important feeder to Philadelphia. The Central Ohio and Wilmington roads have the four feet ten inch gauge.

The Marietta and Cincinnati road is the most southern extension of the Pennsylvania road now in progress. The Company asks for aid from Philadelphia, and looks to the Pennsylvania Railroad Company for efficient assistance and countenance. It is of special importance to us, as being the only route by which the trade of Southern Ohio and Eastern Kentucky can reach Philadelphia, except through Baltimore. The gauge is undetermined, but will be made to correspond with that of Pennsylvania, if Philadelphia aid be obtained; otherwise the weakness of the Company may force a union with the Hillsborough road, on which the gauge of four feet ten inches has been laid down. In this case the Wheeling connexion will be necessarily abandoned. This Company possesses the only single charter covering the entire ground from Wheeling to Cincinnati. Knowing the interest felt in this road by many of the most intelligent merchants of Philadelphia, on account of their business relations with Southern Ohio, Kentucky, and Tennessee, and feeling very doubtful myself about the propriety of affording the amount of aid which would be required from Philadelphia to secure the early completion of the Hempfield and Marietta Railroads, I considered it necessary to look more fully into this case than either of the others, and have become satisfied that the commercial interests of Philadelphia require their prompt construction. I certainly did not expect to arrive at this conclusion when I entered into the examination you required.

The Marietta road is in progress of construction from Marietta to the vicinity of Blanchester. About seventy-seven miles will be completed next fall—the funds and iron for the same being now procured; the determination of the gauge should therefore be made at once. The Company is constructing their road in a permanent manner, and the masonry of the bridges and culverts is of superior quality. The maximum gradient is fifty feet per mile, the minimum radius of curvature two thousand eight hundred and sixty-five feet. The Sciota and Hocking road on the south connects it with Portsmouth, from which point the Maysville and Big Sandy road, now advertised for contract, extends to Maysville. From Maysville, railroads are in progress through Lexington to Danville, which will soon be connected with Nashville and Knoxville.

The line passes through Chilicothe, the former capital of Ohio, and the county seat of Ross, of which the agricultural productions are said to be greater than any county in Ohio, and probably in the United States. To this point the Virginia Central Railroad is aiming, and in a late report of the Chief Engineer of that road upon their proposed extension through Gallipolis to Chilicothe, he speaks of intersecting the Marietta road at that point, "as the key to the whole interior commerce and traveling of the State."

I can see no mode by which Southern Ohio, Eastern Kentucky, and Tennessee, can be made tributary to Philadelphia, except through the Hempfield and Marietta Railroads; and the aid and countenance of Philadelphia appear to be essential to their prompt construction.

The amount which the respective companies ask is $500,000 for the Hempfield, and $750,000 for the Marietta road. With the funds already secured, and the prestige arising from the approval and adoption by Philadelphia of these roads as a part of her grand plan, I believe that these subscriptions will be sufficient to insure the completion of both these roads—the aggregate cost of which will be over eight millions of dollars.

Statement of distances from Philadelphia to Cincinnati by different routes :

No. 1, via Pittsburg, Crestline, and Columbus, . .	717	miles.
2, via Pittsburg, Loudenville, Mount Vernon, and Springfield,	697	"
3, via Pittsburg, Steubenville, Coshocton, Newark, and Columbus, ...	662	"
4, via Greensburg, Wheeling, Zanesville, Newark, and Columbus,	657	"
5, via Wheeling, Zanesville, Wilmington, and Circleville, .	646	"
6, via Wheeling, Marietta, Athens, Chilicothe, . . .	651	"

From the above tabular statement, it will be seen that the length of the Marietta line to Cincinnati is less than any of the others, except No. 5, by Wheeling, Zanesville, and Wilmington, which is only five miles shorter; it is six miles less than Central Ohio; eleven miles less than Steubenville and Indiana; forty-six miles less than Mount Vernon and Springfield; and sixty-six miles less than Ohio and Pennsylvania. Pointing in a different direction and diverging widely from the Ohio and Pennsylvania road, it is not even a competitor for the great legitimate business of that company. For the trade of Cincinnati, it will necessarily be a rival to the other lines, and for this purpose is not essential to Philadelphia; but, as has already been shown, none of the others can give us access to Southern Ohio, Kentucky, and Tennessee—and a good connexion with these is indispensable.

Three railroads appear to be necessary to secure the ends pointed out in the commencement of this report, and, in my judgment, these are: the Ohio and Pennsylvania, with the Fort Wayne extension to Chicago, and connexions with Sandusky and Cleveland; the Pittsburg and Steubenville to Columbus, Indianapolis, and St. Louis; and the Marietta to Cincinnati and Kentucky. With these Philadelphia will have nothing to fear from any quarter. The Cleveland and Pittsburg Railroad Company are about to commence an important extension of their line from Wellsville, the present terminus on the Ohio river, to Wheeling and Rochester; thus forming with the Ohio and Pennsylvania road, and the Marietta and Cincinnati road, a continuous line on the northwestern bank of the Ohio from Pittsburg to Marietta, 160 miles. This may well be called a Grand Junction Railway, as it will connect all the lines I have described with the Pennsylvania Railroad and the Baltimore and Ohio Railroad, uniting no less than nine important railroads at their termini. The gradients and curvatures are extremely favorable, and in case of accident to any of the bridges or ferries proposed, it will be inestimable. I consider it a very important road, both for Philadelphia and Pittsburg.

I have said nothing on the subject of railroad bridges across the Ohio river at Wheeling and Steubenville. The question is of too much magnitude to be summarily disposed of, and in this communication I can only deal in generalities. At Wheeling, five railroads will meet, two on the East bank and three on the West bank. I think there can be no reasonable doubt that the magnitude of the interests involved will produce a harmonious arrangement, by which all these will be accommodated; and I hope the same will be the case with Steubenville.

Referring to the reports and exhibits of the different corporations for more minute details than can be embraced in a general report of this character, I have the honor to subscribe myself,

With great respect,
Edward Miller,
Chief Engineer, Pennsylvania Railroad.

Philadelphia, *Jan.* 27, 1853.

Hodge's Self-Lubricating Axle Box.[*]

This important invention was thus described, in a paper read before the last general meeting of the Institution of Mechanical Engineers, held at Birmingham, at which Mr. Robert Stephenson, M. P., the President, presided:

No part of the machinery of the railway requires constant lubrication more than the axle journals of locomotives, tenders, and carriages, as the heating of one journal in the whole train is sufficient to produce the most serious results, not only in delay to the traffic, but endangering the lives of the passengers in the train.

Notwithstanding the great attention this point has received, scarcely a train that passes over our roads (in the summer more particularly), but some one or more of the axle journals heat. In one instance the writer experienced, the whole train had to be passed into a siding for more than two ours before it could again proceed on its journey. He was induced, hrough what he had experienced of the difficulties attendant on the use of grease as a lubricator, and from what he knew of the use of oil in the United States, to write to the inventor of the best lubricating box in that ountry, knowing that the difference of cost of lubricating was more than one-half in favor of oil, with a proper box. He obtained a patent in his country for the inventor, and on application to Mr. J. E. McConnell, of the London and North Western Railway, a trial of the axle box was at once made on some of their carriages.

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[*] From the London Mechanics' Magazine, December, 1852.

On no railway in the United States is grease used as a lubricator; many patents have been taken out in that country for axle boxes, but the plan now brought before the meeting seems to be preferred, and is universally adopted. The average distance that carriages run there before any addi-ional oil is supplied to the boxes, or before the journals and brasses are examined, is 8000 miles. This fact has been fully corroborated by the working of these boxes on the London and North Western Railway. The first boxes were put on the tender of No. 182 engine, which was immediately put on to the most trying work, during hot weather—some-imes running express trains at the highest speeds, and at other times at he worst possible work—ballasting; and yet, after running 6000 miles in four months, without any additional oil, the journals and brasses were in as perfect a condition as when new.

The axle box consists of an upper chamber, which is filled full of cotton waste, flax, sponge, or any other capillary material, to retain and pass he oil up to the journal. There is also a lower or secondary chamber, for the reception of the dirty oil, which finds its way down the space at he back of the bridge wall, with a tap screw at the bottom to let it out. A covering plate is bolted on to the front of the box, which is its only opening besides the hole for supplying oil, closed by a screw. Upon the axle a wrought iron collar is shrunk, having a groove turned in it to receive a leather flanch.

The results of the trial of the new axle boxes in the tender No. 182, upon the London and North Western Railway, have been officially reported as follows, to Mr. McConnell, by his assistants:—"The axle boxes have up to 20th Sept. last, run 5743 miles; the bearings have been examined, and are found in a very satisfactory state. No oil has been supplied since the first day of running, four months previously: 10 quarts of oil have been supplied to the boxes altogether, and 5 quarts have been drawn off during the time from the bottom chamber, which is still good oil for screwing, drilling, and other ordinary work; the oil remaining in the boxes is considered sufficient, without more being added, to run at least from 3000 to 4000 miles more. The journals and brasses are wearing beautifully, with faces as though polished in the latter; and a great advantage is found, that the great wear endways does not take place on the brasses, as in the ordinary boxes using yellow grease or tallow. The cost of lubrication is greatly reduced, as appears from the following account of the comparative consumption of the above tender with the new axle boxes, and another tender exactly similar, except that it was fitted with old boxes on Normanville's plan, using tallow, both tenders having run the same distance, 6000 miles, under the same circumstances of trains, and the weather being dry and dusty nearly the whole of the time:

New Axle Boxes.

Oil put into the boxes at starting, 10 quarts at 9d.,	7s.	6d.
Credit by 5 quarts drawn off from the bottom chamber, at 6d.,	2	6
Actual cost of oil,	5	0
Cotton waste, 4 lbs., at 2d.,	0	8
Leathers, 4½, at 1s.,	4	6
	10	2

Actual cost per day, 1·54d., or 1½ d. per day.

Old Axle Boxes.

Tallow required per day, 2 lbs. at 4½d., or.	9d per day.
Saving per day on the six new boxes,	7½d per day.

Weight of the six old axle boxes,	3 cwt.	1 qr.	0 lbs.
Weight of the six new axle boxes,	1	2	20
Saving in weight of the six new boxes,	1	2	8

The advantages of this axle box over those now in use are—

Firstly. The perfect exclusion of dirt or grit from the box, by means of the leather and wrought iron collar.

Secondly. The certainty of constant and never failing lubrication to the journals and brasses by means of the capillary medium placed in a separate chamber, and detached from the back of the box by means of the bridge wall, so that the hydraulic lead of the oil can be carried much higher than the joint of the leather and collar, allowing the upper chamber to be full of oil if necessary, while it is impossible that any oil can leak out at the back.

Thirdly. The provision of a secondary or under chamber for the dirty oil to drop into, from which it is drawn off, refined, and again returned to the upper chamber, or is issued in the machine shop for drilling, cutting bolts, and many other purposes, and is equally good as new oil.

Mr. McConnell said he believed the statement in the paper was correct about the results of the trial he had made of the axle box. There was a perfect exclusion of dirt from the journal, and the keeping it constantly in contact with the oil was an important advantage. He was satisfied they must, ere long, abandon grease for oil; there was a great loss of power from defective lubrication of the carriage and wagon journals in cold weather, as there were no lubrication in action on first starting, until the journals got heated, and then they were liable to get too hot, and the grease ran away, and was scraped off the outside of the boxes, and put in again mixed with grit at the stations. Oil was generally ready for action in any weather, and he thought Railway Companies must ultimately adopt oil for all moving journals, particularly with the present increase in the speed of trains, and the weight on the working bearings.

Mr. Lea, of London, mentioned a new material for lubrication that he was bringing into application; it had been tried some years since by Mr.

Ramsbottom, with very satisfactory results; but further trials had been suspended till now, from difficulties of the inventor, who was now dead. This lubricating substance consisted of a peculiar semi-fluid composition, applicable to the present axle boxes; oil was the basis of the composition, but thickened with india rubber and other materials; it had an affinity for the iron bearing, which prevented the displacement of the material from the rubbing surface. The manufacture of the material was not expensive, costing only 4*d*. per lb.; and when charged at 16*d*. per lb. it had been found in the trial made that there was a very considerable saving in the cost of lubrication compared with the ordinary grease or tallow. He wished to make a further trial of it on railways, and thought it would prove an important improvement. There was a great advantage in this plan, from requiring no change in the present axle boxes. No ordinary pressure in the bearings could squeeze out the lubricating material; therefore it remained between the surfaces, preventing contact, and consequently preventing any heating by friction.

Mr. H. Wright said he had known several kinds of oil boxes, but they were all liable to the spilling of the oil from side blows and oscillations. The employment of the cotton waste in the axle box, described in the paper, he thought was decidedly a good plan to prevent the oil from spilling over, and he inquired the result that had been found in the trial on the London and North Western Railway?

Mr. McConnell replied, that there appeared to be no spilling or loss of oil, and the dust and grit were effectually kept out of the box. The oil drawn off from the bottom chamber was very black and thick, and not suitable to use again in that state, though it might be fit for drilling purposes, &c.; but after being properly purified it was very good for lubrication again. There was a bridge at the back of the axle box, just high enough to prevent the oil from flowing off; the oil did not come into contact with the leather joint, which was only to prevent the entrance of grit and dust.

Mr. Chillingworth remarked that there was a plan of lubrication with a cork ball, about 1 inch diameter; two of these balls floated on the surface of the oil, rolling against the journal to distribute the oil. He believed it was a French invention, but did not know the result of its application.

Mr. McConnell said he was not acquainted with that plan. The leather in the new axle boxes was not found to wear away, and appeared likely to last a long time, as there was no pressure or strain upon it; the leather was not bent, but simply fitted easily into the groove in the iron collar, which was shrunk on to the axle.

Mr. H. Wright observed, that the leather would probably wear the iron away before it was worn away itself.

Mr. Allan remarked, that he had used sponge in the axle boxes of engines for the last ten years, and found the results very satisfactory. They found that the consumption of oil, which was previously six to eight quarts for the 100 miles trip between Birmingham and Liverpool, was now reduced to one quart, partly by the introduction of sponge in the axle boxes of the ten bearings of the engine and tender. The plan still continued very successful, and they had adopted it generally in their engines and tenders.

Mr. Forsyth (of Wolverton) remarked, that one circumstance had not been mentioned, in the description of the new axle boxes tried on the London and North Western; the cotton was rammed in tolerably tight from the front, filling the boxes up solid except against the ends of the axles. The cotton was put in dry, and it became gradually saturated, by pouring in oil from time to time at the top hole; it would continue to absorb oil for several days. The surface of the cotton waste, when examined after running the 6000 miles, was like a metallic polished surface next the journal, but still it was found saturated with oil close up to the surface of contact. The leathers were cut straight up three-quarters of an inch from the axle, but not bevelled, to get them into the groove of the iron collar, but no leakage was found to take place, as the cotton was not over saturated, and the oil never came in contact with the leather so high up as the cut.

On the Drainage of Towns. By Mr. R. Rawlinson.*

It was contended that town sewers could not receive the excessive flood waters, even of the urban portion of the site; that they should never receive the suburban drainage, nor be combined with water courses; that they should be adapted solely to remove the solid and liquid refuse from the houses; and that it was safer for the inhabitants that there should be no sewers at all, rather than they should be of such dimensions as to become places of deposit. Pumping could be profitably adopted in certain situations, where from the level, or the effect of tidal influence, the outlet flow might be checked. Intercepting sewers at mid-level were approved. Sewers of minimum dimensions were advocated in connexion with pumping, and they should be capable of resisting internal hydraulic pressure in case of the water rising in them. The flow through sewers should be constant, and it was argued this could only be secured by having small conduits. With regard to earthenware pipes, three inches diameter was considered too small for any drain pipes, and thirty inches diameter too large for the material of which they were made. Pipes of four inches diameter would probably be found the least sectional area that should be used for house drains, and nine inches for streets, and then not at a less gradient than one in sixty. It was decided that the beneficial use of pipe sewers could not be pushed beyond certain limits; but the system should not be entirely condemned because it had been carried to extremes by those who wanted experience. The general success of the use of egg-shaped pipe sewers at Manchester was given as an example of the advantageous adoption of the pipe system. The various kinds of joints were described, and it was recommended not to use pipes of larger diameter than about fifteen inches, as larger sizes were apt to be fractured from unequal bearing at the joints. The difficulty of moulding, drying, and burning pipes increased probably as the squares of the diameters; if large pipes were moulded too thin, they were liable to be crushed in the sewer; and if they were moulded of extra strength, the wet pipes collapsed with their own weight in drying, were twisted out of shape in burning, or were imperfectly vitrified. Sewers of radiated bricks, moulded for the purpose, were better and cheaper than earthen pipes; a sewer thus constructed, three feet in diameter, being cheaper than one of pottery pipe of twenty inches diameter, their relative capacities being as the squares of their diameters; and there was no reason why brick sewers should not be as smooth within, and as impervious, as any pottery pipe. The discussion of the paper was commenced, but adjourned until November 30, when it was announced that the whole evening would be devoted to it.—*Proc. Inst. of Civ. Eng. Nov.* 23.

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* From the London Athenæum for November, 1852.

AMERICAN PATENTS.

List of American Patents which issued from Jan. 11*th, to Feb.* 8*th,* 1853, (*inclusive,*) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

JANUARY 11th.

17. For an *Improvement in Rakes to Harvesters;* Thomas Baylis and Daniel Williams, Tecumseh, Michigan.

Claim.—"What we claim as our invention and improvement is, the construction and method of operating the rake, together with the use of the jointed brake in facilitating the discharge of the sheaf at the rear of the machine, as set forth."

18. For an *Improvement in Lathes for Turning Interior and Exterior Surfaces;* Nathan Chapin, City of New York.

Claim.—"Having described the devices by which turning of profile work is effected, what I claim as my invention is, constructing the clamping heads with a V projection on the interior face, in combination with the orifices, to act through said clamps and V projection, for the purpose of introducing key slats, in order to retain the pieces firmly in position, during the operation of turning the interior and exterior surfaces.

"2d, I claim giving to the sliding and vibrating interior cutter, suspended on the stationary mandrel, motion corresponding to the pattern to be turned, by a rod passing through the stationary mandrel, in the manner and for the purpose herein described."

19. For an *Improvement in Porous Cells for Galvanic Batteries;* Moses G. Farmer, Salem, Massachusetts.

Claim.—"I claim as my invention the improved cell, as made substantially as described, viz. with a part only of it porous, or so as to permit the electricity to pass from the nitric acid or liquid within it, through such part and into the liquid surrounding the cell, the remainder of the cell being made by glazing or other means impervious to the passage of electricity and acid or liquid through it, as specified."

20. For an *Improvement in Scythe Fastenings;* Pinckney Frost, Springfield, Vermont.

Claim.—"What I claim as my invention is, the peculiar construction of the loop and the set ring, with the grooves, in the manner and for the purpose set forth."

21. For an *Improvement in Mode of Operating Circular Saws;* Ammi M. George, Nashua, New Hampshire.

"The nature of my invention consists in supporting and guiding a circular saw, which is driven by friction applied near its periphery, by means of a guard plate, upon which is placed an arbor, fitting a circular opening in the centre of the saw plate, and around which the saw runs, by which means I am enabled to saw boards or veneers of a width almost equal to the diameter of the saw."

Claim.—"Having described my invention, what I claim therein as new is, in combination with a circular saw driven by friction near its periphery, the guard plate with its arbor, around which the saw runs, and by which it is held into the wood, and on which the board or veneer being sawed may rest, and relieve the saw from all friction therefrom, and by which means I am enabled to cut boards or veneers of nearly equal width with the diameter of the saw, substantially as described."

22. For an *Improvement in Fire Polishing Glass;* John L. Gilliland, Brooklyn, N. Y.

Claim.—"What I claim as my invention is, the method, substantially as described, of fire polishing glass by means of a rotating table, provided with a hollow handle, or its equivalent, and gear, by which said table can be rotated, as described."

23. For an *Improvement in Buckles;* Peter P. R. Hayden, City of New York

"The nature of my invention consists in a peculiar manner of uniting or connecting the two ends of the body of the buckle together, viz. by means of a boss formed at each of the ends of the body, said bosses being in contact with each other, and forming a bulb, around which one end of the tongue is clasped; the end of the tongue which surrounds the bulb having a recess or groove in it, in order to prevent the tongue from slipping off of the bulb."

Claim.—"What I claim as new is, constructing the buckle in the manner substantially as herein shown and described, viz. by uniting or connecting the two ends of the body of the buckle by means of a boss formed at each of the two ends of the body; said bosses being in contact with each other, and forming a bulb, around which one end of the tongue is clasped; the end of the tongue which surrounds the bulb having a recess or groove in its inner surface, which conforms to the convexity of the bulb, and keeps or binds the bosses firmly together, and also keeps the tongue in its proper place."

24. For an *Improvement inManure Spreaders;* Silas A. Hedges, Lancaster, Ohio.

"My improvements consist in constructing a cart with two bodies, the front one of which is capable of being raised so as to discharge the manure into the rear one, by means of throwing a shaft, which is connected with the front end of it, by a tackle, into gear with the hind axle; and in providing an inclined endless apron in the rear body, which is also actuated by the hind axle, and so arranged with the tail board, that by means of a lever it is thrown into gear simultaneously with the raising of the tail board."

Claim.—"Having fully described my invention, what I claim therein as new is, constructing a manure cart with two bodies, the front one of which is raised or tilted for the discharge of manure into the rear one, by the action of the hind axle, by means of the axle and tackle, when thrown into gear by the hand lever, arranged and operating in the manner and for the purpose set forth.

"I also particularly claim the combination of the endless apron, the tilting body, and raising the tail board simultaneously with throwing in gear the endless slotted apron, in the manner and for the purposes fully set forth."

25. For an *Improvement in Manufacturing Copying Paper;* William Mann, Philadelphia, Pennsylvania; ante-dated July 11, 1852.

Claim.—"What I claim as my invention is, the copying paper herein described, composed of Manilla fibre or the equivalent thereof, tempered with cotton or its equivalent, substantially as herein set forth."

26. For an *Improvement in Screw Cutting Dies;* Andrew Mayer, Philadelphia, Penn.

Claim.—"What I claim as my invention is, arranging solid dies between the side plates, or their equivalents, of a stock, in such a manner that they are free to play, to a limited distance, in a plane perpendicular to the axis of the bolt or pipe to be screwed, while they are at the same time incapable of revolution in the same plane, substantially in the manner and for the purposes described."

27. For an *Improved Method of Connecting the Sheets of Sheet Flue and Water Space Steam Boilers;* Richard Montgomery, City of New York.

Claim.—"Having described my improvements in steam boilers, what I claim as new is, riveting together the overlapping flanches of the opposite sides of the sheet flues in steam boilers in the manner described, whereby the flues are firmly attached each to each, and the usual flue sheet is dispensed with; and also certain advantages in construction attained in other parts of the boiler, as described.

"I also claim the method of connecting a series of flues and water spaces with the roof or arch of the fire box, by means of tongues, which project from the latter and are secured alternately to the faces of the water spaces and to the tops of the flues."

28. For an *Improvement in Smut Machines;* Dan Pease, Jr., Floyd, New York.

Claim.—"What I claim as my invention is, the employment of the adjustable deflector, set at an angle to throw the grain in different directions, in combination with the receiver, the top of the said receiver being adjustable to any height desired, and the front piece of the same being set in such a position, in relation to the deflector, that it will, when the grain strikes the deflector, be thrown against the said plane surface, which from its peculiar position will throw the grain in a partially spread state up against the adjustable top, which causes it to spread still more, and then to fall down on the ribbed bottom, and pass off through the wind pipe.

"I also claim causing the grain to spread to a greater or less degree, by making the top of the receiver adjustable to different heights, in the manner and for the purpose herein described."

JANUARY 18TH.

29. For an *Improvement in Operating the Treadles of Looms;* Robert W. Andrews, Stafford, Connecticut.

"The nature of my invention consists in operating each treadle by means of a mover, having two outwardly acting cam surfaces of unequal lengths combined in one piece, in such a manner that the portion of the said mover upon its arbor can be reversed for the purpose of doubling its capacity for producing different movements and retentions of the treadles, substantially as hereinafter set forth."

Claim.—"What I claim as my invention is, operating each treadle by means of a mover, having two outwardly acting cam surfaces of unequal lengths combined in one piece, and producing the movements and retentions, substantially as herein set forth. I also claim such a form and arrangement, respectively, of the treadles and the movers, that the treadles can be reversed in their positions upon their fulcrums, and thereby cause a reversal of the movement and retentions of the said treadles, substantially as herein set forth."

30. For an *Improvement in Bedstead Fastenings;* Charles L. Bauder, Cleveland, Ohio.

Claim.—"What I claim as my invention is, the fastening of bedsteads by the use of a metal bar, having upon its extremities, arms with inner faces formed of sections of screws; which arms work against the faces of castings, secured in the bed posts, and to the ends of the rails, thus drawing the ends of the rails against the posts; the faces of these castings against which the arms of the bar work, being likewise constructed of sections of screws, the joint being kept close, and the bedstead firm, by the pressure of the slat frame, caused by the weight of the bed and its occupants, upon arms attached to the metal bar; thus forming a self-tightening fastening, the whole being constructed and arranged as herein fully set forth."

31. For an *Improvement in Machinery for Reducing Metal Bars;* Dexter H. Chamberlain, Assignor to Cyrus G. Howard, Boston, Massachusetts.

Claim.—"What I claim as my improvement is, the combination of the bolster with the three rollers, as arranged and made to operate together, substantially in manner and for the purpose as specified; the object of the said bolster being to prevent the over-riding, or squeezing out of the metal, so as to form a fin between the rollers, as stated."

32. For an *Improvement in Saddle-Trees;* Joseph Contner, Milroy, Pennsylvania.

Claim.—"Having described the nature of my improvement, what I claim as my invention is, connecting the bridge spring seat to the pommel of the saddle, by hooking or fastening the hook or curvature, on the front end of the longitudinal centre spring of the bridge spring seat, to the semi-oval or semi-circular steel or iron plate or strap, fastened down underneath the pommel, by screws or otherwise, through its legs to the legs of the pommel, to give additional spring or play by its motion on its pivots to the seat, and to allow the bridge spring seat to be disconnected from the frame of the saddle when necessary, and to strengthen the pommel by rendering the hole through it near the horn (which weakens it) for connecting with the seat unnecessary."

33. For an *Improvement in Driving Circular Saws, &c.;* George and David Cook, New Haven, Connecticut.

Claim.—"What we claim is, the curved or hooked tooth pinion, acting in the manner and for the purposes herein before set forth."

34. For an *Improvement in Harness Boards for Jacquard Looms;* Edward Everett, Lawrence, Mass., and Samuel T. Thomas, Lowell, Massachusetts.

"Our invention is designed to facilitate the operation of changing the relative position of the mail cords or heddles, in a jacquard loom, when the number of threads in a given breadth of the cloth is to be increased or diminished; our improvement being confined to that part of the loom commonly called the 'hole board.' "

Claim.—"What we claim is, the sectional harness board, in combination with the movable supporting bars, placed on each side of the frame for the purpose of adjusting and retaining said harness boards in the position required; the whole constructed, combined, and arranged, in the manner and for the purpose specified."

35. For an *Improvement in Wool Condensers;* James S. Hogeland, Lafayette, Indiana.

Claim.—"Having described my improved wool condenser, what I claim as new therein is, the method herein described, of detaching the ropeings from the rub roller, and guiding them on their passage to the spool, in such manner as to prevent them from being unequally deflected, and thereby unequally stretched, by means of a relief and guide roller, arranged and operating substantially as herein set forth."

36. For an *Improvement in Screw Cutting Dies;* John Griffiths, Philadelphia, Pa.

Claim.—"What I claim as my invention is, the circular die with an offset, which makes a cutting edge, which is held in position by a bolt and screw nut, the threads which are cut in its periphery being parallel, instead of having a running pitch, substantially in the manner and for the purposes as herein before described."

37. For an *Improvement in Compounds for Stereotype Plates;* John L. Kingsley, City of New York.

Claim.—"Having stated clearly the nature, and described the process of preparing my gum compound, specially adapted to the stereotype plates and moulds, I wish it to be distinctly understood, that I do not claim the mixture of the gums, gutta percha, india rubber, etc., with other non-elastic gums, resins, etc., or shellac, sulphur, etc.; nor do I claim vulcanizing; nor do I use vulcanized compounds; nor do I claim mixing the elastic gums with the alkaline earths, or earth proper; nor with the carbonates; nor the sulphates of these bases, as pulverized marble, plaster of paris, epsom salts, etc.; all of these things having been done before by Nelson Goodyear and others, for hardening and otherwise modifying the elastic gums; but what I do claim as my invention is, the making of stereotype moulds and plates of the raw or uncured gum, combined with the pulverized oxide of iron and antimony, or their equivalents, in manner and for the purpose herein set forth."

38. For an *Improvement in Corn Shellers;* Jeremiah P. Smith, Hummelstown, Penn'a.

Claim.—"What I claim as new are, the beveled spring blocks, or shelling bars, in separate pieces, in the manner and for the purpose set forth in the preamble and specification; but I do not claim to be the inventor of spring blocks or shelling bars."

39. For an *Improvement in Valves of Rotary Steam Engines;* Joseph W. Webb, Assignor to Benjamin Gould, Aurora, New York.

Claim.—"Having fully described my invention, what I claim is, making two exhaust openings, such as described, separate and distinct from each other, through each steam and cut-off valve; said valves having seats on the upper as well as lower side of the steam chamber, each of said exhaust openings communicating with the exhaust chamber, through apertures in the upper side of the steam chamber, which are opened and closed at pleasure, by slides used in connexion with the valves for governing or reversing the engine."

40. For an *Improvement in Seed Planters;* Samuel and William Witherow, Assignors to Samuel Witherow, Gettysburgh, Pennsylvania.

Claim.—"Having fully described the nature of our invention, what we claim therein as new is, the arranging of the spring slide and roller, within a box or tube forming one end of the hopper, in such manner as to prevent any more seed from leaving the hopper than is required for planting; the whole being arranged in the manner and for the purpose specially set forth. We also claim the arrangement of the drag bar under the plough beam, and passing through the adjustable hanger, and a slot in the neck of the mould board, for the purpose of giving additional lateral support to it, and protecting it from the earth which runs up in the mould board in turning the furrows; the whole being arranged and combined in the manner and for the purpose herein set forth and described."

JANUARY 25th.

41. For *Improvements in Method of Joining Corners of Boxes, &c.;* John Bell, Harlem, New York.

"The nature of my invention consists in so forming a joint at the corners of boxes, drawers, or similar articles, as to prevent their coming apart when the lid or bottom is fastened on, thereby being secured in a manner superior to dovetailing or other modes heretofore known."

Claim.—"What I claim as my invention is, the joining of corners of boxes, &c., by means of double oblique parallel mortises and tenons, so that neither the sides nor ends can be separated or displaced without previous removal of the top and bottom of the box, as set forth substantially in the foregoing specification and accompanying drawings."

42. For *Improvements in Working the Condenser attached to Steam Diaphragm Pumps;* James Black and Orson Beecher, Philadelphia, Pennsylvania.

Claim.—"What we claim as our invention is, 1st, The pipe and valves, or their equivalents, so constructed and arranged as to draw the air, &c., from the condenser, and drive it into the discharge pipe, or elsewhere, by the column of water in said pipe, operated by the working of the diaphragm, which causes said column of water to work the equivalent of an air pump to the condenser.

"2d, The pipe and valve, or their equivalents, so constructed and arranged as to draw the water from the condenser by the raising of the diaphragm, thus causing the water pump to work an exhaust pump, or its equivalent, to the condenser, at the same time that it does its ordinary work, substantially as described."

43. For an *Improvement in Manufacturing Wigs:* Chas. Bourgard, City of N. York.

Claim.—"Having fully described my invention, I do not confine myself to the precise means of giving motion to or adjusting the several parts essential to the operation of the machine; I know that it is possible to move and adjust them in other ways, to produce the same effect; and I do not claim the employment of the hooked or bearded needle, irrespective of the manner of its employment. But I claim (for the purpose of making the partings, or those parts of wigs and all articles of a similar nature where the artificial scalp or skin is visible, and the surrounding parts,) the employment of two or more adjustable slide frames, for carrying the silk or other material into which the hair is to be inserted, and the hair to be inserted therein, in combination, substantially as described, with a reciprocating hooked or barbed needle, either the said frame or needle having such a movement as is necessary to insert the hairs at a proper distance apart."

44. For an *Improvement in Tanning Hides and Skins;* Henry Bretney, Springfield, O.

Claim.—"Having described my improved process of tanning hides, what I claim as new therein is, continuously towing the hides in separated layers through the tanning liquor, in such manner that each hide, made fast only at one edge or end to the towing mechanism, will be greatly stretched and kept spread out by the resistance of the liquor, which is caused freely to circulate in contact with both sides or surfaces of the hides, whereby every hide, of quantity however large, is equally and constantly exposed to the action of the tanning liquor, and the stretching action upon the hides adjusted, substantially as specified."

45. For an *Improved Feed Motion in Sewing Machines;* Freeman Palmer, Conneaut, O.

Claim.—"What I claim as my invention is, the arrangement and combination of parts, by which the material to be sewed is carried under the needle in a way to secure any required length of stitch, consisting of the shaft and the screw regulator, together with the lever and clamp upon the feed wheel, substantially as herein described."

46. For an *Improvement in the Manufacture of Seamless Felt Wearing Apparel, &c.;* Samuel M. Perkins, Springfield, Pennsylvania.

Claim.—"Having described my invention, what I claim is, the art or method, as described, of making seamless felt articles of use and wearing apparel, by giving the batting of wool or fur the desired shape, and uniting its edges where required with silk or any other non-shrinking equivalent, or by such shrinking threads or fibre as will resume their original state when dry, substantially as herein before set forth.

"I do not claim the mode of carding or preparing the batting, as that is well known long before my invention; nor do I claim the shrinking or felting process, as that has also been well known."

47. For an *Improvement in Machines for Paring Apples;* William H. Lazell, City of New York, Assignor to Henry F. Willson, City of New York, and S. E. Fenwick, Washington, D. C.

Claim.—"What I claim is, the apple paring machine, constructed with a stationary circular rack or way, in combination with a traversing lever for operating the fork, on which the apple or other article is placed, the said handle having a pinion on it, which traverses the said rack and gives rotary motion to the fork, making the apple to revolve against the swinging spring knife, while the handle is pushed backwards and forwards in a horizontal direction by the operator, in the manner substantially as described, for the purpose set forth."

48. For an *Improvement in the Frames of Piano Fortes;* Jos. Piffaut, N. Orleans, La.

"The nature of my invention consists in so constructing the metallic frames of piano fortes as that the inside frame, or that which supports the long bridge of the piano, may be raised or lowered at pleasure, and thus raise or lower the tone of the instrument, and at the same time keep up the general accord of the piano."

Claim.—"Having fully described my invention, what I claim therein as new is, in combination with the metallic frame of a piano forte, the movable part which supports the bridge, and which is raised or lowered at pleasure by means of a key operating through the screws and levers, or their equivalents, for the purpose of raising or lowering the tone of the instrument, and at the same time preserving its accord, substantially as described."

49. For an *Improvement in Sugar Draining Machines;* Joseph W. Archibald, Porto Rico, West Indies, Assignor to Horace Southmayd, City of New York.

Claim.—"Having described the nature and operation of my invention, what I claim as new is, the employment of fibrous or flexible bag, made of cotton. linen, hair cloth, or any other substance, placed loosely or secured by loops, as described, in a centrifugal depurating sugar machine, inside of the wire gauze cylinder, and containing the sugar; said bag not being permanently attached to the machine, by any screw or clamp, &c., but to be freely placed in, and then lifted out of the machine entirely, when the sugar is depurated, for the purposes set forth."

50. For an *Improved Gold Washer and Amalgamator;* Abiather F. Potter, Boston, Mass.

Claim.—"What I claim as my invention is, 1st, A wheel, or its equivalent, arranged in the tube above mentioned, so as to be operated by the water containing the metals, &c., as it issues into or descends in the tube, so as to agitate the water, by the motion of the wheel, whether it is made to operate some other agitating apparatus or otherwise.

"2d, I also claim the openings, *f f*, or their equivalents, in combination with the openings, *t t*, or their equivalents, substantially as described, for giving such direction to the water as will move the mercury, in the manner and for the purposes set forth, substantially as described."

51. For an *Improvement in Expanding Drills;* Thomas Prosser, City of New York.

Claim.—"Having described several means of applying my invention, I do not profess to conform myself to any of them, as to the mere mode of operating the screw, and thereby causing the cutter to advance or expand simultaneously with the operation of cutting or drilling. What I claim is, the combination of the inclined cutter, with a screw cut thereon, bevel screw pinion, or its equivalent, and collar, arranged in the manner described, so that by holding said collar during the rotation of the drill, a continuous feed motion is communicated to the cutter."

52. For an *Improvement in Omnibus Registers;* Peter Taltavull, Washington, D. C.

Claim.—"Having fully described my improved omnibus register, what I claim therein as new is, the spring, operated and arranged in combination with the inclined planes and escapement tube, in the manner and for the purpose substantially as herein described."

53. For an *Improvement in Winnowers of Grain;* Augustus B. Childs, Rochester, New York; patented in England, May 22, 1852.

Claim.—"I claim the regulating of the blast for the second winnowing of grain, by combining with the revolving fan which generates both the first and second blast, and compensating safety valve, as herein set forth; but I make no claim to a spring valve in itself, as such a contrivance is well known for various purposes.

"I also claim the self-regulating valve, which prevents the admission of air into the machine while it opens to discharge the impurities separated from the grain, and thus prevents an undue accumulation of them at the bottom of the air chamber."

Re-issues for January, 1853.

1. For an *Improvement in Reaping Machines;* Wm. F. Ketchum, Buffalo, New York; patented July 10th, 1847; re-issued 11th January, 1853.

Claim.—"What I claim is, the crooked arm or coupling piece, separate or in combination with the cutter bar, whether both be composed of one, two, or more pieces. I also claim attaching, supporting, and sustaining said cutter bar to the frame, relatively to the driving wheel, substantially as herein described and represented, and for the purpose set forth. I also claim the endless chain, sickled edged cutter, in combination with the pulleys and rack teeth, arranged and operating substantially as in the manner and for the purpose set forth."

DESIGNS FOR JANUARY, 1853.

1. For a *Design for a Cooking Stove;* Sherman S. Jewett and Francis H. Root, Buffalo, New York, January 25.

Claim.—"What we claim as new is, the device "prairie flower," on the front plate; the arrangement and configuration of the floral device ornamenting the side door, consisting of a full blown central flower, stems, foliage, and pendant flowers, and the ornamental configuration of the smaller door, as herein represented and described."

2. For a *Design for a Wood Stove;* Sherman S. Jewett and Francis H. Root, Buffalo, New York, January 25.

Claim.—"What we claim as new therein is, the configuration and arrangement of the ornamental device on the side plates of the stove, as represented and described. We also claim the ornamental design of the fire door, as represented and described. We likewise claim the ornamental configuration of the bottom plate, as described."

3. For a *Design for a Cooking Stove;* Sherman S. Jewett and Francis H. Root, Buffalo, New York, January 25.

Claim.—"What we claim as new therein is, the configuration and arrangement of the ornamental design of the plate, as shown and described."

4. For a *Design for a Cooking Stove;* Joseph G. Lamb, Cincinnati, Ohio, Assignor to Alexander Bradley, Pittsburg, Pennsylvania, January 25.

Claim.—"What I claim as new is, the arrangement and combination of the ornaments, mouldings, panelings, and shapes, into the above specified design for cooking stove, substantially as above shown."

5. For a *Design for a Cooking Stove;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, January 25.

Claim.—"I claim the ornamental configuration or design, substantially as represented in the drawings, and as above described."

FEBRUARY 1st.

1. For an *Improvement in Machinery for Cutting Barrel Heads;* Chas. B. Hutchinson, Waterloo, New York.

"My invention consists in the use of clamp rings to hold the wood for the head, and present it to be cut and dressed by rotating cutters; said cutters being arranged upon a rotating disk and arms, in a peculiar combination to be hereafter described in detail, in such a manner, that the head may be cut out, face dressed, and beveled or chamfered on the edge, by a single operation."

Claim.—"In relation to the head turning apparatus, I am aware that there is nothing novel in the use of clamp rings as such, or of rotating cutting tools, such as flem knives, chamfering chisels, and face planers, set on disks or otherwise; but the peculiar combination and arrangement of all these, which I have adopted, I believe to be wholly novel and not heretofore used either for the purpose herein specified, or any other. What, therefore, I claim as new is, the use of clamp rings to hold the pieces of heading, and hung in bearings on opposite sides, or in any equivalent way, so as to be reversible, in combination with the adjustable rotating cutters to cut and bevel the edge of the head, and with the face cutters arranged upon the disk substantially as described, whereby the opposite sides of the head may be successively presented to the action of the cutting tools, and the head cut out, chamfered, and face dressed, or cut out and chamfered only, at one operation."

2. For an *Improvement in Frames for Lanterns:* Elijah F. Parker, Proctorsville, Vermont.

Claim.—"I am aware that offsetts have been turned on the frames of lanterns, for holding the glass, &c., but the corner pieces are made up of two or more pieces soldered together: this I do not claim: but what I do claim as my invention is, the turning of grooved or sunken flanches upon the frames of lanterns, so that when the top and bottom are united, the flanches for holding the glass, mica, or their equivalents, shall be already in place to receive them, without any further soldering, substantially as herein described."

3 For an *Improved Screw Wrench;* George B. Read, City of New York.

"The nature of my invention consists in having the shank of the adjustable jaw pass through a recess in the stationary jaw, which is attached by a pivot to the end of the wrench stock; the shank of the adjustable jaw is provided with a rack, into which a pawl attached to the end of the wrench stock catches."

Claim.—"I do not claim having the jaw attached to a shank, and the shank passing through a recess in the jaw, independent of the mode of operating the jaws, for the above device, differently modified, as employed in various wrenches now in use; but what I claim as new is the arrangement of the several parts, as herein shown and described, viz: the jaw being attached by a pivot to the stock, and said jaw having a recess through it, through which recess the shank of the adjustable jaw passes—the shank being provided with a rack, into which a pawl attached to the end of the stock catches—said pawl being kept into the rack by the spring, by which arrangement, the two jaws are forced against the side of the nut, as the handle of the wrench is turned, and the jaws made to bear or bind harder upon or near the corners of the nut, thus preventing the jaws from slipping around it."

4. For an *Improvement in Portable Gas Apparatus;* William and Matthias Stratton, Philadelphia, Pennsylvania.

"The nature of our improvement consists in constructing a stove retort, and cooler, all arranged, so as to be portable, in the strict sense of the term, which may be used for the manufacture of illuminating gas from rosin or other suitable material."

Claim.—"Having described our portable gas apparatus, what we claim as our invention is, in the construction of the stove, of removable gates in the ends for the introduction of the retort, and the movable section under the rosin holder, in the manner as set forth and shown."

5. For an *Improvement in the Mode of Feeding Rosin in the Fires of Glass Furnaces;* Benjamin Shiverick, North Sandwich, Massachusetts.

Claim.—"I claim the combining the long conical valve and the discharge tube, by means of a set screw and nut and supporting spring, whereby the flow of the melted rosin may not only be regulated, but when any interruption takes place, the attendant can readily remove the same, either by lifting the valve or pressing on it, and such valve be subsequently moved back to its former position by the spring; this improvement being a very important one in the operation of the apparatus."

6. For an *Improvement in Manufacture of Indian Rubber;* Richard Solis, New Brunswick, New Jersey.

"The nature of my invention is the art of remanufacturing what is commonly known and called metallic, vulcanized, or insoluble rubber."

Claim.—"I therefore claim as my invention the manufacture of india rubber fabrics by the mixture of ground or powdered vulcanized rubber, with the ordinary india rubber of commerce."

7. For an *Improvement in Voltaic Batteries and Apparatus for Medical and other Purposes;* Issac L. Pulvermacher, Breslau, Prussia; patented in Austria, Oct. 9, 1849.

Claim.—"I do not claim, simply, making galvanic elements of negative and positive metals, with porous, non-conducting substance interposed, as in the well known galvanic pile; what I do claim as my invention is, constructing galvanic elements of positive and negative metals, separated from each other, by a porous, non-conducting substance, when the said porous, non-conducting substance is surrounded and held by one or both the said metals, substantially as specified and for the purpose specified. I also claim forming the galvanic elements, by coiling, in the form of helices, the positive and negative wires, in grooves, previously made in the surface of an inner core of wood, or other porous substance, substantially as specified, so that when the wires are wrapped around in the said grooves, they shall both be in contact with porous substance within, and separated from each other as specified. I also claim, forming a chain of a series of elements, substantially such as herein described, by means of ties or links, substantially as and for the purpose specified. And finally, I claim the method of interrupting the current of electricity, by means of the spring vibrating conductor interposed, substantially as herein described, for the purpose of breaking and closing the circuit, by the movement of the human body, or other like motion, as set forth."

FEBRUARY 8TH.

8. For an *Improvement in Purifying Fatty Matters:* Jean Baptiste Moinier and Pierre Hyppolyte Boutigney, Paris, France; patented in France, November 14, 1849.

Claim.—"What we claim as our invention and discovery is, the introduction and mingling of a current or currents of sulphurous acid gas, with mixtures of fatty acids and alkalies, preparatory to the process of being converted into candles, tapers, and articles for burning, thereby rendering such mixtures of a superior quality, and causing them to burn with a stronger, clearer, and brighter light."

9. For an *Improvement in Hot Air Furnaces;* Nathaniel A. Boynton, Boston, Mass.

Claim.—"I do not claim a hollow ring radiator, placed over and made to communicate with the chamber of combustion; but what I do claim is the hollow "wheel radiator," made with a hollow rim, hollow spokes, a hollow hub (open at top and bottom), and a valve and valve seat, so made and applied to the hub, that when the valve is closed, it shall cause the heat and volatile products of combustion to pass through one or more of the arms, and into and through the hollow rim, and thence out of the said rim, through the other arm or arms, and into the hub, and over the valve, and also, so that when the said valve is opened, the heat and volatile products of combustion may pass directly up through the hub, without first circulating through the hollow arms and rim, substantially as specified."

10. For *Improved Arrangement of Centre Board and Rudder for Shoal Water Vessels;* George Chase, Prudence Island, Rhode Island.

Claim.—"I am aware that one rudder, made to slide within the other, and attached to centre board, has been used, so that one shall rise with the other; but in this case, there is no indication by which it can be known when the sliding rudder is up or down, and when used; thus I lay no claim to them; but what I do claim is, attaching the rear end of the movable centre board and the rudder to the sliding stern post, so that the said centre board, stern post, and rudder, may be raised or lowered together, substantially as described, and by which means, I only use a single rudder, whose position can always be known by the height of the stern post to which it is hung, as also that of the centre board; the sliding stern post serving as an indicator to the positions of both."

11. For an *Improvement in Hanging Farm Gates;* John Filson, Milroy, Penn.

Claim.—"What I claim as my invention is, the lower double jointed hinge, in combination with the apparatus attached to and constituting the upper hinge, for the purpose of holding the gate at any inclination required, for the purpose set forth."

12. For *Improvements in Core Bars for Forming Cores for Casting Pipes;* George Peacock, West Troy, New York.

"The nature of my invention consists in providing a lozenge shaped iron bar, having semicircular or other shaped wings or projections on its lower half; said bar, which I term the core bar, is fitted with a core box, and the sand packed and adjusted around it; the wings or semicircular projections binding the sand and causing it to adhere to the lower portion of the bar. The sand is placed over the upper portion of the bar, and rounded or shaped perfectly semicircular, by meansof a sweep. The bar, when properly encompassed by the sand, forms the core. The core bar may be so arranged, as to be adopted to form cores for elbows, branch pipes, &c., &c., and also be properly anchored, so as to allow pipes of any desired length to be cast."

Claim.—"Having thus described my invention, what I claim as new is, the core bar, having transverse wings or projections of semi circular or other shape, corresponding to the shape of the article to be cast; said wings or projections permitting the sand to be rammed, for forming the lower half of the core, and holding or binding the sand to the lower part of the bar, and allowing the upper half of the core to be made by the sweep, as herein set forth. I also claim the manner of anchoring the core bar, viz: by means of the metal strips or bridges fitting in recesses in the upper surface of the core bar; said bridges resting upon wooden supports, and having anchor rods bearing upon their upper surfaces, the liquid metal burning out the wooden supports and allowing the core to be withdrawn, by which means the core is prevented from being raised or forced upward, by the liquid metals, as it is poured into the mould; and thus enabling pipes to be cast of any desired length. I also claim the manner, substantially as herein described, of connecting or jointing the core bars, for forming cores for elbows or branch pipes, viz: by means of wooden wedges, which are the means of holding the bars together while the core is being formed; said wedges being burnt out by the liquid metal, when poured into the mould, and allowing the cores to be withdrawn."

13 For an *Improvement in Moulds for Uniting Steel to Cast Iron;* Charles Peters, Trenton, New Jersey.

Claim.—"What I claim as my invention is, the use of a solid base to moulds, in which steel or wrought iron is to be welded to cast iron, with an aperture in the same, so that by means thereof, the said steel or wrought iron can be subjected to the heat of the furnace, while in the mould."

14. For an *Improvement in Winnowers;* George F. S. Zimmerman, Charlestown, Va.

Claim.—"Having fully described the construction, operation, and advantages of my improved threshing and cleaning machine, what I claim as new is, the invention, use, and application of the perforated vibrating table, arranged to a sloping bottom, or platforms, the parallel, saw like strips, or straw pushers, combined with an oscillating rake and straw beaters, or curved prongs; the whole combined and working with the oscillating hinged standard and suspending straps, as shown in diagram and substantially as set forth. I do not, however, claim the invention of a combined threshing, separating, and winnowing machine, but only such parts as are set forth in my specification."

15. For an *Improvement in Gas Metres;* Edward R. Hallam, and Thomas B. Barnard, Brooklyn, New York, Assignors to E. R. Hallam, New Haven, Connecticut.

Claim.—"What we claim as our invention is, the within described method of constructing metres, with one cylinder working within another, so that the gas passes alternately into the inner cylinder and out of the space above it, and then out of the inner cylinder, while the supply enters the space above it; the gas being changed in its course or direction, by valves, as herein described."

16. For an *Improvement in Surgical Instruments for Examining the Ear, &c.;* H. Le Riemondie, of New Orleans, Louisiana; ante-dated October 23, 1852.

"The object of my invention is so to construct such an instrument, that the part to be examined, is seen by light reflected upon it from the interior of the instrument."

Claim.—"What I claim as my invention is, the construction of an instrument for examining the interior of the ear, nose, eye, or other part of the human system, by the combination of the reflectors, the lens, case, tubes, and lamp, substantially in the manner herein specified."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Physical Lines of Magnetic Force. By Prof. Faraday.*

On a former occasion, certain lines about a bar magnet were described and defined, (being those which are depicted to the eye by the use of iron filings sprinkled in the neighborhood of the magnet,) and were recommended as expressing accurately the nature, condition, direction, and amount of the force in any given region either within or outside of the bar. At that time the lines were considered in the abstract. Without departing from or unsettling anything then said, the inquiry is now entered upon, of the possible and probable *physical existence* of such lines. Many powers act manifestly at a distance; their physical nature is incomprehensible to us: still we may learn much that is real and positive about them, and amongst other things something of the condition of the space between the body acting and that acted upon, or between the two mutually acting bodies. Such forces are presented to us by the phenomena of gravity, light, electricity, magnetism, &c. These when examined will be found to present remarkable differences in relation to their respective lines of forces; and at the same time that they establish the existence of real physical lines in some cases, will facilitate the consideration of the question as applied especially to magnetism. When two bodies, *a*, *b*, gravitate towards each other, the line in which they act is a straight line, for such is the line which either would follow if free to move. The attractive force is not altered, either in *direction* or *amount*, if a third body is made to act by gravitation or otherwise upon either or both of the first two. A balanced cylinder of brass gravitates to the earth with a weight exactly the same, whether it is left like a pendulum freely to hang towards it, or whether it is drawn aside by other attractions or by tension, whatever the amount of the latter may be. A new gravitating force may be exerted upon *a*, but that does not in the least affect the amount of power which it exerts towards *b*. We have no evidence that *time* enters in any way into the exercise of this power, whatever the distance between the acting bodies, as that from the sun to the earth, or from star to star. We can hardly conceive of this force in one particle by itself; it is when two or more are present that we comprehend it: yet in gaining this idea we perceive no difference in the character of the power in the different particles; all of the same kind are *equal*, *mutual*, and *alike*. In the case of gravitation, no effect which sustains the idea of an independent or physical line of force is presented to us; and as far as we at present know, the line of gravitation is merely an ideal line representing the direction in which the power is exerted. Take the sun in relation to another force which it exerts upon the earth, namely, its illuminating or warming power. In this case rays (which are lines of force) pass across the intermediate space; but then we may affect these lines by different media applied to them in their course. We may alter their direction either by reflection or refraction; we may make them pursue curved or angular courses. We may cut them off at their origin, and then search for and find them before they have attained their object. They have a relation to *time*, and occupy eight minutes in coming from the sun to the earth: so that they may exist independently either of their source or their final home, and have in fact a clear, distinct physical existence. They are in extreme contrast with the lines of gravitating power in this respect; as they are also in respect of their condition at their terminations. The two bodies terminating a line of gravitating force are alike in their actions in every respect, and so the line joining them has like relations in both directions. The two bodies at the terminals of a ray are utterly unlike in action: one is a source, the other a destroyer of the line; and the line itself has the relation of a stream flowing in one direction In these two cases of gravity and radiation, the difference between an abstract and a physical line of force is immediately manifest. Turning to the case of static electricity, we find here attractions (and other actions) at a distance as in the former cases; but when we come to compare the attraction with that of gravity, very striking distinctions are presented, which immediately affect the question of a physical line of force. In the first place, when we examine the bodies bounding or terminating the lines of attraction, we find them as before, mutually and equally concerned in the action; but they are not alike: on the contrary, though each is endued with a force which, speaking generally, is of the like nature, still they are in such contrast that their actions on a third body in a state like either of them are precisely the reverse of each other,—what the one attracts the other repels; and the force makes itself evident as one of those manifestations of power endued with a dual and antithetical condition. Now with all such dual powers, attraction cannot occur unless the two conditions of force are present and in face of each other through the lines of force. Another essential limitation is, that these two conditions must be exactly equal in amount, not merely to produce the effects of attraction, but in every other case; for it is impossible so to arrange things that there shall be present or be evolved more electric power of the one kind than of the other. Another limitation is, that they must be in physical relation to each other; and that when a positive and a negative electrified surface are thus associated, we cannot cut off this relation except by transferring the forces of these surfaces to equal amounts of the contrary forces provided elsewhere. Another limitation is, that the power is definite in amount. If a ball *a* be charged with 10 of positive electricity, it may be made to act with that amount of power on another ball *b* charged with 10 of negative electricity; but if 5 of its power be taken up by a third ball *c* charged with negative electricity, then it can only act with 5 of power on ball *a*, and that ball must find or evolve 5 of positive power elsewhere: this is quite unlike what occurs with gravity, a power that presents us with nothing dual in its character. Finally, the electric force acts in curved lines. If a ball be electrified positively and insulated in the air, and a round metallic plate be placed about 12 or 15 inches off, facing it and uninsulated, the latter will be found, by the necessity mentioned above, in a negative condition; but it is not negative only on the side facing the ball, but on the other or outer face also, as may be shown by a carrier applied there, or by a strip of gold or silver leaf hung against that outer face. Now, the power affecting this face does not pass through the uninsulated plate, for the thinnest gold leaf is able to stop the inductive action, but round the edges of the face, and therefore acts in curved lines. All these points indicate the existence of physical lines of electric force:—the absolutely essential relation of positive and negative surfaces to each other, and their dependence on each other, contrasted with the known mobility of the forces, admit of no other conclusion. The action also in curved lines must depend upon a physical line of force. And there is a third important character of the force leading to the same result, namely, its affection by media having different specific inductive capacities. When we pass to dynamic electricity, the evidence of physical lines of force is far more patent. A voltaic battery having its extremities connected by a conducting medium, has what has been expressly called a current of force running round the circuit, but this current is an axis of power having equal and contrary forces in opposite directions. It consists of lines of force which are compressed or expanded according to the transverse action of the conductor, which changes in direction with the form of the conductor, which are found in every part of the conductor, and can be taken out from any place by channels properly appointed for the purpose; and nobody doubts that they are physical lines of force. Finally, as regards a magnet, which is the object of the present discourse. A magnet presents a system of forces perfect in itself, and able, therefore, to exist by its own mutual relations. It has the dual and antithetic character belonging to both static and dynamic electricity; and this is made manifest by what are called its polarities, *i. e.* by the opposite powers of like kind found at and towards its extremities. These powers are found to be absolutely equal to each other; one cannot be changed in any degree as to amount without an equal change of the other, and this is true when the opposite polarities of a magnet are not related to each other, but to the polarities of other magnets. The polarities or the *northness* and *southness* of a magnet, are not only related to each other, through or within the magnet itself, but they are also related externally to opposite polarities, (in the manner of static electric induction,) or they cannot exist; and this external relation involves and necessitates an exactly equal amount of the new opposite polarities to which those of the magnet are related. So that if the force of a magnet *a* is related to that of another magnet *b*, it cannot act on a third magnet *c* without being taken off from *b*, to an amount proportional to its action on *c*. The lines of magnetic force are shown by the moving wire to exist both within and outside of the magnet; also they are shown to be closed curves passing in one part of their course through the magnet; and the amount of those within the magnet at its equator is exactly equal in force to the amount in any section including the whole of those on the outside. The lines of force outside a magnet can be affected in their direction by the use of various media placed in their course. A magnet can in no way be procured having only one magnetism, or even the smallest excess of northness or southness one over the other. When the polarities of a magnet are not related externally to the forces of other magnets, then they are related to each other: *i. e.* the northness and southness of an isolated magnet are externally dependent on and sustained by each other. Now, all these facts, and many more, point to the existence of physical lines of force external to the magnets as well as within. They exist in curved as well as in straight lines; for if we conceive of an isolated straight bar magnet, or more especially of a round disk of steel magnetized regularly, so that its magnetic axis shall be in one diameter, it is evident that the polarities must be related to each other externally by curved lines of force: for no straight line can at the same time touch two points having northness and southness. Curved lines of force can, as I think, only consist with physical lines of force. The phenomena exhibited by the moving wire confirm the same conclusion. As the wire moves across the lines of force, a current of electricity passes or tends to pass through it, there being no such current before the wire is moved. The wire when quiescent has no such current, and when it moves it need not pass into places where the magnetic force is greater or less. It may travel in such a course that if a magnetic needle were carried through the same course it would be entirely unaffected magnetically, *i. e.*, it would be a matter of absolute indifference to the needle whether it were moving or still. Matters may be so arranged that the wire when still shall have the same diamagnetic force as the medium surrounding the magnet, and so in no way cause disturbance of the lines of force passing through both; and yet when the wire moves, a current of electricity shall be generated in it. The mere fact of motion cannot have produced this current: there must have been a state or condition around the magnet and sustained by it, within the range of which the wire was placed; and this state shows the physical constitution of the lines of magnetic force. What this state is or upon what it depends cannot as yet be declared. It may depend upon the ether, as a ray of light does, and an association has already been shown between light and magnetism. It may depend upon a state of tension, or a state of vibration, or perhaps some other state analogous to the electric current, to which the magnetic forces are so intimately related. Whether it of necessity requires matter for its sustentation will depend upon what is understood by the term *matter.* If that is to be confined to ponderable or gravitating substances, then matter is not essential to the physical lines of magnetic force any more than to a ray of light or heat; but if in the assumption of an ether we admit it to be a species of matter, then the lines of force may depend upon some function of it. Experimentally mere space is magnetic; but then the idea of such mere space must include that of the ether, when one is talking on that belief; or if hereafter any other conception of the state or condition of space rise up, it must be admitted into the view of that, which just now in relation to experiment is called mere space. On the other hand, it is, I think, an ascertained fact, that ponderable matter is not essential to the existence of physical lines of magnetic force.—*Trans. Roy. Insti. June* 11*th*, 1852.

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* From the London Athenæum, July, 1852.

For the Journal of the Franklin Institute.

Speed of the Transatlantic Steamships, during the year 1852. By B. F. Isherwood, Chief Eng. U. S. Navy.

Finding it necessary for my own information to know the fair average performances of the Atlantic steamships for the last year, I constructed the following tables, in which "the longest," "the shortest," and the "mean passage" are given, with the speed per hour in geographical miles of 6082$\frac{2}{3}$ feet, at which the mean passage was made. The time of making the passage is the *true* time, not the apparent; 4 hours and 45 minutes being allowed as the difference between the American and British ports. The speed of the vessels per hour is calculated for the following distances, viz:

New York (battery) to Liverpool, ...	3084	geo. miles
Boston to Liverpool, via Halifax, ...	2883	"
New York to Cowes, ...	3120	"
New York to Glasgow, ...	3000	"
Philadelphia to Liverpool, ...	3250	"

In remarking the speeds of the screw vessels plying between Liverpool and Philadelphia, it must be borne in mind, that the time given, and from which the speed is computed, is from dock to dock; and that the latter city being situated on the Delaware river 110 miles from the ocean capes, obstructions are frequent in its navigation, from fogs, ice, narrowness of the channel, &c., causing occasional detentions, which being included in the time given, make the vessel's speed appear somewhat less than the truth. The steamers plying to New York and Boston suffer detentions from these causes in a less degree.

Table of Passages made by the Boston branch of the Cunard line of Steamships, for the eleven months commencing Jan. 1st, 1852, and ending Nov. 30th, 1852.

Name of Vessels.	From Boston to Liverpool.					From Liverpool to Boston.				
	No of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.	No of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.
Canada,	7	13 4 15	10 11 45	11 6 23	10·6628	6	12 23 30	10 10 15	11 6 7	10·6730
Cambria,	3	13 3 15	11 3 15	11 22 55	10·0477	2	15 14 18	12 7 15	13 23 00	8·6060
America,	7	12 12 45	10 18 15	11 13 2	10·4068	8	15 22 30	10 19 15	12 7 3	9·7712
Europa,	1	11 6 45	11 6 45	11 6 45	10·6482	1	15 2 15	15 2 15	15 2 15	7·9641
Niagara,	6	13 15 45	10 17 00	12 1 40	9·9528	6	14 2 00	11 22 25	12 11 42	9·6196
Means,				11 15 14	10·3248				12 8 9	9·7350

Table of the Passages made by the New York and Liverpool Steamships for the eleven months commencing Jan. 1st, 1852, and ending Nov. 30th, 1852.

COLLINS LINE.

Names of vessels.	From New York to Liverpool.					From Liverpool to New York.				
	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles. per hour.	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.
		d. h. m.	d. h. m.	d. h. m.			d. h. m.	d. h. m.	d. h. m.	
Pacific,	7	13 15 43	10 19 45	11 14 41	11·6048	6	14 21 30	9 21 15	11 10 33	11·2399
Atlantic,	6	12 6 35	10 10 45	10 23 17	11·7138	5	14 13 15	10 0 30	11 5 3[illegible]	11·4413
Arctic,	6	11 11 15	10 3 00	10 22 3	11·7687	7	13 14 30	10 1 15	11 5 1[illegible]	11·4511
Baltic,	4	12 23 45	10 14 15	11 10 52	11·2198	4	11 14 15	10 10 45	11 1 21	11·6224
Means,				11 5 40	11·4362				11 6 14	11·4125
CUNARD'S LINE.										
Asia,	7	13 2 45	10 9 55	11 8 51	11·3029	8	12 23 45	10 14 45	11 14 37	11·0688
Africa,	8	12 15 35	10 14 45	11 5 19	11·4511	7	13 15 15	10 7 15	11 13 52	11·0980
Means,				11 6 58	11·3813				11 14 16	11·0828
Niagara,	1	12 0 15	12 0 15	12 0 15	10·6990					
Canada,	1	11 22 00	11 22 00	11 22 00	10·7832	1	17 16 30	17 16 30	17 16 30	7·2666
Europa,	7	12 15 45	11 1 00	11 19 36	10·8745	7	12 15 15	10 22 45	11 20 45	10·8305
Means,				11 20 23	10·8446				12 14 13	10·2044

As the *Asia* and *Africa* are the only two vessels of the Cunard line, that for size and power can be put in competition with the Collins steamers, it is proper to confine any comparison to them alone—and from the above table it appears, that the mean passage of the Collins steamers from New York to Liverpool was only 1 hour and 18 minutes *shorter* than the mean passage of the Cunard line. The mean passage of the Collins steamers from Liverpool to New York was 8 hours and 2 minutes *shorter* than the mean passage of the Cunard line. It thus appears that in both directions the Collins steamers have made the greatest speed, but in so very slight a degree over their competitors as to be scarcely entitled to the name of victory. Indeed, the mean of the passages from New York to Liverpool may be considered identical when the great distance traversed is taken into consideration; and the difference of 8 hours 2 minutes required by the Cunard line to make the passage from Liverpool to New York, in which head winds and seas are encountered in a greater proportion than in the other direction, may be ascribed to the greater resistance offered by their fuller bows above water, and the greater quantity of their spars and rigging. It is well known that the average consumption of coal by the vessels of both lines per voyage is about 900 tons; the paddle wheels are substantially the same, and the losses of effect from them about equal. The steam is used, however, in the Collins vessels at a higher rate of expansion than in the Cunarders, but the mean effective pressure in both is about the same. We are not therefore entitled to ascribe any decided superiority to either in wheels, engines, boilers, or model, but in the kind of rig, and in keeping the bow lines sharp high above water, so as to diminish the resistance of the vessel when struck by head seas. The arrangement of the Collins vessels seems to be the most judicious.

The three vessels, *Niagara*, *Canada*, and *Europa*, (comprising with the *Asia* and *Africa*, the New York branch of the Cunard line,) though of much inferior size and power to the Collins steamers, have nevertheless maintained a high rate of speed; the mean of their passages from New York to Liverpool being only 14 hs. and 43 mins. longer than the mean of the Collins passages in the same direction. The one westerly passage made by the *Niagara*, in which she broke down and put into Halifax, has been omitted; and if we omit also the exceptional single passage of the *Canada*, and confine ourselves to the mean of the *Europa's* passages from Liverpool to New York, we shall find it but 14 hours and 31 minutes longer than the mean of the corresponding Collins passages.

Table of the Passages made by the New York and Havre, and by the New York and Bremen Steamships, between New York and Cowes, for the eleven months commencing Jan. 1st, 1852, and ending Nov. 30th, 1852.

NEW YORK AND HAVRE LINE.

Names of vessels.	From New York to Cowes.					From Cowes to New York.				
	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.
		d. h. m.	d. h. m.	d. h. m.			d. h. m.	d. h. m.	d. h. m.	
Franklin,	5	13 4 45	10 17 45	11 18 51	11·0306	4	12 7 45	10 3 15	11 12 30	11·2840
Humboldt,	5	16 0 15	11 11 30	13 9 12	9·7136	4	13 1 15	11 4 45	12 2 00	10·7586
					NEW YORK AND BREMEN LINE.					
Washing.	6	22 4 45	13 4 45	15 10 55	8·4115	5	15 3 15	13 12 15	14 8 45	9·0500
Hermann.	4	13 15 55	12 6 45	13 1 44	9·9449	4	13 4 45	11 10 15	12 5 55	10·6151

Table of the Passages made by the New York and Glasgow Screw Steamship Glasgow, *plying between New York and Glasgow, for the eleven months commencing Jan.* 1*st*, 1852, *and ending Nov.* 30*th*, 1852.

Name of vessel.	From New York to Glasgow.					From Glasgow to New York.				
	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.
		d. h. m.	d. h. m.	d. h. m.			d. h. m.	d. h. m.	d. h. m.	
Glasgow,	6	15 16 5	12 21 45	14 18 5	8·7099	5	14 22 15	12 12 15	14 4 59	9·0448

Table of the Passages made by the Philadelphia and Liverpool Screw Steamships, for the eleven months commencing Jan. 1*st*, 1852, *and ending Nov.* 30*th*, 1852.

Names of vessels.	From Philadelphia to Liverpool.					From Liverpool to Philadelphia.				
	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.	No. of passages.	Longest passage.	Shortest passage.	Mean passage.	Speed of the mean passage in geo. miles per hour.
		d. h. m.	d. h. m.	d. h. m.			d. h. m.	d. h. m.	d. h. m.	
City of Gl.	7	18 19 45	15 10 15	16 8 36	7·1942	6	23 20 45	13 18 25	16 21 2	8·0237
C. of M'r.	6	18 4 15	13 3 45	15 23 49	8·4783	5	17 11 21	13 12 15	15 6 44	8·8621

It has generally been supposed that the *very weak* point of the screw propeller, compared with the paddle wheel, was its inability to proportionally maintain the speed of the vessel against head winds and seas; in other words, that the difference between the speeds of the screw vessel in going with the wind and against the wind, was very much greater than the difference between the speeds of the paddle wheel vessel in the same circumstances. Now, it is known that for the greater part of the year, westerly winds and seas prevail; therefore, the foregoing tables should show in a marked manner this characteristic of the screw, if it exist. No such difference, however, can be observed; on the contrary, taking the three screw steamships *Glasgow*, *City of Glasgow*, and *City of Manchester*, the mean of the westerly passages of the first is actually 13 hours and 6 minutes *shorter* than the mean of the easterly passages. This, of course, throws out the exceptional passage of February, when the *Glasgow* was obliged to put into Halifax, and was 22 days making the voyage; but even including this passage, the mean westerly voyage is but 13 hours and 47 minutes *longer* than the mean easterly one. The mean westerly passage of the second, the *City of Glasgow*, is only 12 hours and 26 minutes *longer* than the mean easterly passage; while the mean westerly passage of the third, the *City of Manchester*, is 17 hours and 5 minutes *shorter* than the mean easterly passage. From the foregoing tables, then, it appears that no greater difference exists between the speed of these screw vessels going with and against the weather, than between the speeds of the paddle wheel vessels under the same circumstances. That strong westerly winds prevail for the greater part of the year, between our Atlantic ports and the British islands, is proven by the fact, that the sailing packets are from one and a half to twice as long making the westerly as the easterly passage.

Table showing the mean speeds of the Atlantic Steamships for the Easterly and for the Westerly Passages; and also the mean Speed of the Easterly and Westerly passages; for the eleven months commencing Jan. 1st., 1852, and ending Nov. 30th, 1852.

PADDLE WHEEL STEAMERS.

Name of vessels.	Easterly passages; mean speed in geographic. miles per hour.	Westerly passages; mean speed in geographic. miles per hour.	Mean speed of the easterly and westerly passages in geo. miles per hr.	Names of vessels.	Easterly passages; mean speed in geographic. miles per hour.	Westerly passages; mean speed in geographic. miles per hour.	Mean speed of the easterly and westerly passages in geo. miles per hr.
Canada,	10·6778	10·1864	10·4489	Pacific,	11·6048	11·2399	11·4364
Cambria,	10·0477	8·6060	9·4710	Atlantic,	11·7138	11·4413	11·5899
America,	10·4068	9·7712	10·0678	Arctic,	11·7687	11·4511	11·5977
Europa,	10·8462	10·4722	10·6592	Baltic,	11·2198	11·6224	11·4211
Niagara,	10·0594	9·6196	9·8564	Franklin,	11·0306	11·2840	11·1432
Asia,	11·3029	11·0688	11·1780	Humboldt,	9·7136	10·7586	10·1780
Africa,	11·4511	11·0980	11·2863	Washington,	8·4115	9·0500	8·7017
				Hermann,	9·9449	10·6151	10·2800
SCREW STEAMERS.							
Glasgow,	8·7099	9·0448	8·8621	City of Glasgow,	7·1942	8·0237	7·5770
				" Manchester,	8·4783	8·8621	8·6528

For the Journal of the Franklin Institute.

A Plan for Aerial Navigation by means of Steamers, without the aid of a Balloon. By THEODORE POESCHE.

The old problem of the navigation of the air, which has been agitated for thousands of years, is apparently on the eve of solution. For seventy years our balloons have floated in the air like ships without a rudder, and without the possibility of control. In more recent times, steam has been employed to propel the balloon, thus making it possible at the same time to direct it. A vessel of this description was launched into the atmosphere at the Hippodrome of Paris, a few weeks ago, and tacked at pleasure.

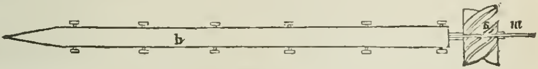
I would now submit to the consideration of adepts, a plan for dispensing with the support of a balloon. This suggestion may be regarded as an improvement upon our present aerial navigation; but it may with equal or greater propriety be looked upon as an advanced stage of nautical travel. I take a modern steamer in its most perfect form, and propose such modifications as will enable it to pierce the air in the same manner as it now sends over the water. In the age of the magnetic telegraph, which must shortly encircle and centralize the whole earth's surface, aerial navigation becomes a logical necessity; the wires are the nerves of humanity, which unite its sensations; they imperatively call for corresponding organs of motion, such as only the air-ship affords. I publish the plan, in order to hear the opinions of those who are competent to decide; the common interest of humanity cannot be better advanced than by their concerted mental labor. The problem in question most nearly concerns the common interest of the race, for it furnishes the only means for the attainment of their highest political, social, and intellectual development.

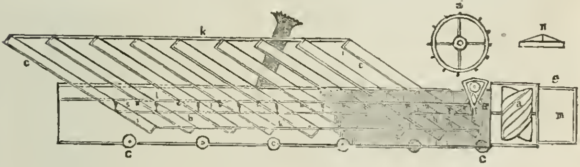
The prominent characteristics of our most modern ship building appear to me to be the following:

1, Their superior buoyancy. Iron ships are in increasing request for the ocean; they are 50 per cent. lighter than wooden ones. On rivers, the lightest species of craft are hooped boats, which have but half the weight of iron ships, or one-fourth of that of a wooden vessel of the same dimensions; they are constructed of light wooden planks, ribbed with iron hoops.

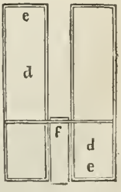
2, Their slender form; their proportions are approaching those of Indian canoes. The English steamer *Wave Queen* is 200 feet long, and but 13 feet wide, making the ratio 16 to 1. Her trips are of unequalled swiftness.

3, The almost universal introduction of the screw propeller, which must ere long do away with the paddle wheel altogether.





Starting upon these considerations, I propose to build a vessel of the least possible weight, long and narrow, making the relative proportions for a larger vessel 20 to 1. The ship to be propelled by a screw, *a*. The screw must work in the air with the same effect as in the water. The greater elasticity of the air will compensate for its want of density. The screw, however, is larger than that of a nautical vessel, and has 12 blades of boiler iron. The elasticity of the air permits this increase, as it will instantly rush in to fill the vacuum. Unlike the screw used for water, every blade of the screw used for the air shall have on its upper edge the strip of a cylindrical plane, the axis of which would coincide with that of the propeller, in order to prevent the too rapid escape of the air.



The ship has a flat bottom, *b*, upon which the sides rise perpendicularly, and runs on broad wheels of short diameter, *c*. When the screw is put in motion by the engine, *the ship will run over the ground upon the wheels.* For the purpose of ascension, the ship is furnished at its sides with large inclined planes of double glued canvass, *d*, stretched upon iron frames, *e*, which act like the plane of a boy's kite. These planes turn upon iron axes, *f*, which are adjusted under the heavy beam of the deck, *g*. An iron rod, *h*, gives the means of turning these axes, and regulating the angle of inclination. Let them be fixed at an angle of 45°, and the vessel be propelled rapidly by means of the screw, and the air, compressed by their resistance, will lift the ship. To retard the escape of the air at the edges of the planes, it is necessary to attach narrow lateral planes to the frames projecting forwards at right angles, *i*. Thin iron rods connect the frames above and below, *k*, and a stronger one, *l*, the axes. The angle of the planes determines the ascension or declension of the ship; the lateral direction is conducted by means of a rudder, *m*, also consisting of double glued canvass, stretched upon an iron frame. As the ship is propelled rapidly forwards, the rudder must act upon the water as it would upon the air. The deck, *n*, tapers off at an angle of 140°. The sides must be particularly strengthened, to withstand the pressure from behind.

In conclusion I observe, that the flight of birds and insects depends upon the principle of the screw. The wing is a screw blade, which works up and down, and thus exerts the force of an inclined plane. As it is concave underneath, and convex above, it compresses the air below it, and thus supports the body of the animal. *My ship most nearly resembles the flying fish, which progresses by means of the spiral action of the tail, while its extended fins support it for a time in the air.*

Where the tonnage is the same, a vessel will not require more power in the air than in the water. The latter is necessarily heavier, and must expend, in overcoming the inertness and the adhesion of the water, nearly the same amount of waste force as the former, in compressing the air for its support.

We may possibly, in time, get a motive power more adapted for the purpose, such, for instance, as carbonic acid; but, however, the present improved steam engine seems to be entirely adequate to the purpose.

Philadelphia, January, 1853.

For the Journal of the Franklin Institute.

The United States Steamer Water Witch. By B. F. Isherwood, Chief Eng., U. S. Navy.

(*With a Plate.*)

The original *Water Witch* was a small *iron* vessel that had undergone several transformations in the Navy, until the hull becoming finally unseaworthy and condemned, while the engine remained good, a *wooden* hull was ordered to be built for it, with new boilers of the "sheet water space" or "Lamb and Summer" kind, and new overhung paddle wheels, with *perpendicular* paddles. The whole of the work, hull and machinery, was executed at the Washington Navy Yard. To render an account of he performance of the vessel of value, it will be necessary to give the limensions of the hull and machinery, which are as follows, viz:

Hull.

Length on water line at 7 feet 10 inches draft, in clear of rabbets,	150 feet.
Beam on deck, extreme,	23 "
Depth of hold,	11 " 6 inches.
Mean draft, with half coal in and other weights full,	7 " 10 "
Displacement at 7 feet 10 inches draft,	450 tons.
Displacement per inch of draft at 7 feet 10 inches draft,	6·09 "
Immersed amidship section at 7 feet 10 inches draft,	149·4 square feet.
Burthen,	393 tons.

Engine.—One inclined condensing engine, with balance puppet valves, cutting off vith the steam valve by Sickels' arrangement.

Diameter of cylinder,	37½ inches.
Stroke of piston,	6 feet.
Space displacement of piston per stroke,	45 cubic feet.
Steam space between cut-off valve and piston, at one end of the cylinder,	2·25 "

Paddle Wheels.—Perpendicular paddle wheels, overhung.

Diameter from outside to outside of paddles,	19 feet.
Length of paddle,	5 "
Width of paddle,	36 inches.
Number of paddles in one wheel,	10.
Area of two paddles,	30 square feet.
Immersion of lower edge of paddles at 7 ft. 10 in. draft of water,	3 feet 6 inches.

Boilers.—(Plate IV.)—Two iron boilers, with sheet water spaces. The boilers are placed side by side, with one smoke chimney in common; each boiler contains 14 flues, 45 inches high by 2 inches wide in the clear, and 66 inches long; the water spaces between the flues are 1 5-12 inch wide in the clear. The upper part of the front or furnace end of the flues is bricked *down* 18 inches from the top, for the purpose of forcing the heated gases to enter at the bottom. There is a permanent water space hanging bridge at the back end of the flues, for the purpose of retaining the heated gases in the top of the flues until the heat is sufficiently extracted to allow them to descend by their gravity, and pass under the bottom of the bridge into the chimney.

Length of each boiler,	18 feet 9 inches.
Breadth of each boiler,	6 "
Height of each boiler,	9 "
*Area of the total heating surface in the two boilers,	1831 square feet.
*Area of the total grate surface in the two boilers,	61 "
*Aggregate cross area of flues at front end, *below* the brick work, in the two boilers,	10·416 "
*Aggregate cross area of flues in the two boilers,	17·333 "
*Aggregate cross area between bottoms of hanging bridge and flues in the two boilers,	9·778 "
Cross area of the smoke chimney,	21·647 "
Height of the smoke chimney above the grates,	42 feet 9 inches.
Capacity of steam room in the two boilers,	467 cubic feet.
Weight of sea water contained in the two boilers, (by the scales,)	34,000 pounds.
Weight of the two boilers,	66,200 "

Proportions.

Proportion of heating to grate surface,	30·016	to 1·000
" grate surface to cross area of flues at front end, below the brick work,	5·856	"
" " " of flues,	3·519	"
" " " between bottoms of hanging bridge and flues,	6·239	"
" " " of smoke chimney,	2·818	"
Cubic feet of steam room per cubic foot of space displacement of piston per stroke,	10·378	

* As used on the trip from Washington to Baltimore, and as finally adopted.

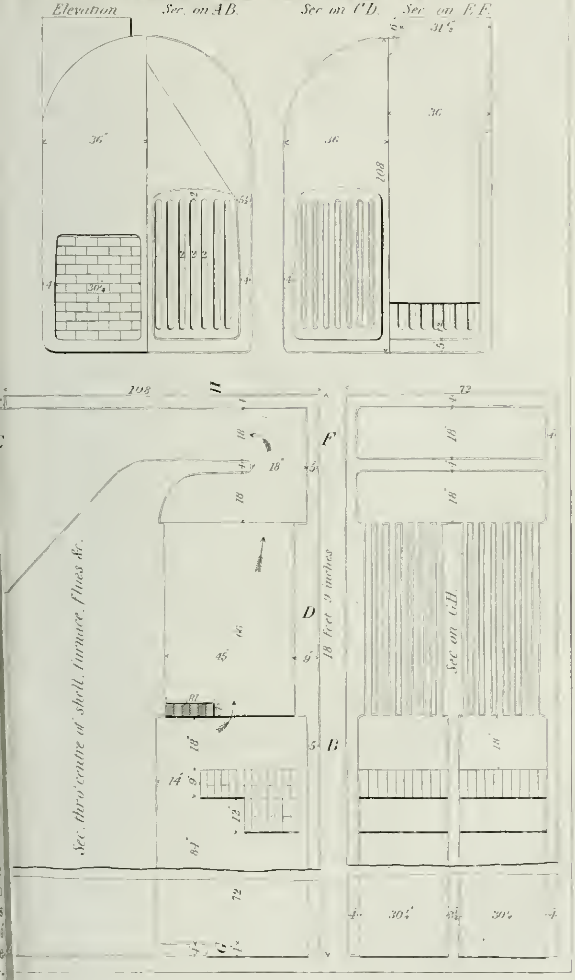
Performance at the Dock.—Before making the trial trip, the machinery was set in motion and worked at the Dock, to which the vessel was of course securely fastened. The top edge of the lowest paddle coincided with the level of the water, or the paddles were *awash*. In this condition, with a mean effective pressure of 24·6 pounds per square inch by indicator, the wheels made 11 revolutions per minute; and with a mean effective pressure of 16·15 pounds per square inch by indicator, the wheels made 9 revolutions per minute. It will be observed that the revolutions, 11 and 9, are nearly in the proportion of the square roots of the pressures, 24·6 and 16·15 pounds.

On the day of the first trial at the Dock, the furnaces were fired with the Cumberland bituminous coal, and steam began to form in one hour and five minutes, the temperature of the water being about 40° Fah. Owing, however, to defective packing of the valve stems, the working of the engine was discontinued until the next day, when the furnaces were again fired with Cumberland bituminous coal, and steam obtained in one hour from water of the temperature of 40° Fah.

During these experiments with Cumberland coal, it was remarked with surprise that no smoke issued from the chimney top, as in ordinary cases this fuel gives off a dense black smoke, especially in starting fires. On opening the door in the chimney, it was perceived that no smoke entered from the flues, and there was no external indication of bituminous coal being used, the appearance from the chimney being the same as if anthracite had been used; in fact, the combustion was perfect. In the furnaces, however, there was the ordinary appearance of smoke. To account for this result, so different from what ordinarily follows the combustion of this coal, it is necessary to glance at the manner in which it enters into ignition.

All coal being of vegetable origin, is composed of the same constituents, but in different proportions, as the vegetables from which it is formed; these constituents are carbon, hydrogen, and oxygen. In coal they are found mixed with a small per centage of earthy or metallic substances, which being incombustible, do not require to be considered. These constituents form new combinations with each other, the oxygen and hydrogen uniting with the carbon, and forming respectively carbonic acid gas and carburetted hydrogen gas. These combinations are constantly going on among the solid constituents of the coal, even at ordinary temperatures; and the gaseous products are continually passing off, producing in coal mines the *choke damp* and the *fire damp* of miners. Now, hydrogen ignites at a greatly less temperature than carbon, and when carburetted hydrogen gas is distilled in considerable quantities in the furnaces of a steam boiler, if the temperature be too low for the ignition of the carbon, but high enough for the ignition of the hydrogen, the latter will burn, that is, enter into chemical union with the oxygen of the atmospheric air, and forming vapor of water, liberating the carbon, which will be disengaged in the form of the solid, black, impalpable particles called smoke, and so pass off into the atmosphere, being a total loss of that much fuel, beside carrying with it the heat expended to give it the difference of temperature between what it had when it entered the furnaces and when it left the flues of the boilers. But if the temperature be

Boilers of U.S.S.
WATER WITCH.



sufficiently high, the carbon will burn as well as the hydrogen; that is, will enter also into chemical combination with the oxygen of the atmosphere, and form carbonic acid gas, a colorless gas, which passes off by the chimney, and has of course no appearance of smoke. The oxygen disengaged from the coal, also being present, contributes to the formation of these compounds; but as much more than a sufficient quantity is, with ordinary proportions of boilers, admitted through the grates for that purpose, it would be useless, could it be prevented, to expend heat in distilling what can be already obtained without cost in the gaseous form.

From the foregoing it will be perceived, that the main cause of smoke is the want of a sufficient temperature to ignite the carbon; but even with this temperature, smoke would exist were the carbon not intimately mixed with oxygen, and this mixing evidently is greatly promoted by reverberations, eddies, and currents in the flues, with time to effect it; the want of these eddies and of time is a cause but little less important than too low temperature of the production of smoke in the furnaces and flues of steam boilers.

With bituminous coal, smoke always exists in the furnaces, though it sometimes disappears in the flues if a large body of the heated gases is kept together for a short time and exposed to comparatively little cooling surface; for by this arrangement the temperature is maintained and the mixing with oxygen effected. In the furnaces, where smoke always exists, the temperature is the highest, but time and currents are wanting for the mixture; for the gases pass off rapidly towards the flues in one unbroken mass as they are distilled from the coal. In general, the heated gases from a boiler furnace is exposed too soon, before time is had for mixing, to a comparatively large extent of heating surface, by which the temperature is at once lowered below the point of ignition, for the carbon and smoke produced. It is well known that smoke can be greatly prevented, and as a consequence, a saving of fuel effected, by firing with small or thin charges, as in this case not enough cold fuel is introduced at once to materially lower the temperature of the furnace over the grates. For the same reason, it is found judicious to fire one-half of a furnace at a time, covering it with fresh fuel, and leaving the surface of the remaining half in full ignition.

In the boilers of the *Water Witch*, the doors of each furnace were in pairs, extending across the whole width. The furnace was fired half at a time, one of the doors only being opened and the other remaining closed. The course of the heated gases was considerably changed, and they were exposed to several eddies and reverberations before they reached the chimney. After passing from the furnace over the brick bridge wall, they impinged directly against the brick work placed in the top of the front end of the flues, by which the current was turned directly downwards; after it had passed below this brick work, it rose by specific gravity to the top of the flues, undergoing another reverberation or eddy behind the bricks; and finally, after reaching the hanging bridge at the back end of the flue, it was again deflected downward, and made its escape beneath the bridge into the chimney. In addition to undergoing these eddies and reverberations, the gases were kept in large masses in the flues comparatively to the heating surface exposed to them in a given time. The cubic contents of each flue is 3·4 cubic feet, and its heating surface is 42·3 square feet, or 12·441 square feet of surface per cubic foot of gas, while the distance to be traversed is only 5 feet 6 inches. Between the brick bridge and the flues the gases are kept in one undivided mass, and the brick bridge itself acts as a maintainer of equable temperature after it has once been heated up, giving out heat to the gases whenever their temperature falls below it.

While discussing the features of the boiler, it may be of value to give an account of an incident connected with its performances, showing how much the position of the draft opening affected the result. During the working of the engine at the Dock and on the succeeding trial trip, there was a brick wall (fig. 1) built up 7 inches high, immediately beneath the hanging bridge at the back of the flues, leaving 11 inches opening between the top of the wall and the bottom of the bridge. This was done with a view to contract the opening at that place, and prevent the gases from passing too rapidly into the chimney. After the trial trip, this wall was removed, and an iron plate was attached to the hanging bridge, depending 6 inches below it, leaving the distance between the bottom of this plate and the bottom of the back connexions 12 inches. On starting fires again to work the engine at the Dock, it was now found that the draft, which with the brick wall arrangement was very strong, burning about 12 pounds of hard Lackawanna anthracite per square foot of grate per hour, with $42\frac{3}{4}$ feet of smoke chimney above the grates, was almost wholly annihilated. Instead of 1 hour and 15 min. which had been required on the trial trip to get steam from water at 40° Fahr. with the same coal, there were now required three hours and a-half, and the after production of steam was as slow in proportion as its first generation, the boiler furnishing only about one-third the quantity of steam per unit of time as previously. On looking into the furnaces, the surface of the coal appeared dull and black, and the flame curled lazily around, as in a baker's brick oven; the chimney was cool, and every indication showed the draft to be stopped off; yet the only attention that had been made was the substitution of the plate for the wall, and shifting the opening 6 inches lower, while the opening itself had been increased one-eleventh. These modifications are shown in the accompanying sketch.

After a little consideration, I detected the difficulty; the error consisted in considering the distance of 12 inches between the bottom of the plate and the bottom of the back connexions as the effective opening, whereas the *effective* opening was only the vertical distance between the bottom of the plate and the line produced of the bottoms of the flues, shown dotted in the sketch. Reckoning this as the *effective* opening, it would only be 5 in. high, or an area to each furnace of 151·25 sq. in., while the area of each furnace grate was 2178 square inches, or the proportion was 1·0 of opening to 14·4 of grate surface; previously, during the experiments at the Dock and on the trial trip, this proportion, with the wall arrangement, was 1·000 to 6·546, or more than double. The plate was now removed, the wall was not restored, and the effect was again the same as on the trial trip, as the presence of the wall produced no result. On the passage from Washington to Baltimore the boiler was as shown in the large engraving.

By observing the sketch, it will be perceived there could exist no force to expel the air lying in the bottom of the back connexions below the line of the bottoms of the flues. That portion of the boiler being both the *lowest* and the *coolest*, and lying rectangularly below the current of hot gases issuing from the bottoms of the flues, the air contained in it could neither be *pushed* out by this current, nor be *heated* so as to rise by its diminished specific gravity and pass out with the general current up the chimney. The effect was the same as though the space beneath the dotted line had been filled with solid matter.

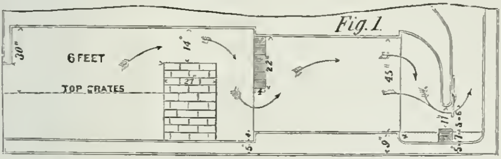


Fig. 1.

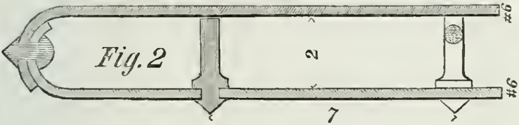


Fig. 2

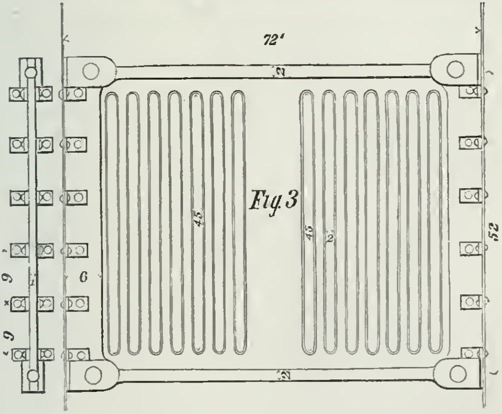


Fig. 3

On trying the boilers with hard Lackawanna anthracite, they were found to require one hour and a quarter to make steam, and about two hours to bring the fires to steady, regular action. The anthracite was in lumps about the size of a large man's fist; the Cumberland coal was chiefly fine, and both were of good quality. In starting fires, but a very small quantity of pine wood was used with either. The grate bars were — inches thick, with — inch air spaces between.

Bracing of the Boilers.—The bracing of this kind of boilers at the flues is peculiar; it is represented in fig. 2. The flat flues it will be observed are braced in the fire spaces, and *not* in the flat spaces, as in ordinary boilers. These braces are studs of wrought iron, with a collar on the inside abutting against one side of the flue; this side of the flue is punched, and the outer end of the stud passed through it and riveted over; the opposite side of the flue only abuts against or touches the other end of the stud, as the force to be withstood is that of compression solely. Of course, with this system, it is absolutely necessary to fit the boilers with an air valve opening inward by the atmospheric pressure, or a *vacuum valve*, as it is commonly called.

It is obvious on inspection, that the sides of the boilers cannot be braced from, or stayed to the sides of the side flues, because of the unbalanced pressure that would result on those flues; for the studs communicate the pressure from one side of the flue to the other, and if this other be again stayed to the side of the boiler, it is plain the pressure on one side of the flue and on the side of the boiler will be in the same direction; and these two pressures will only be resisted by the pressure on the other side of the flue. Now, as the pressures on each side of the flue balance each other only, it would leave the pressure on the side of the boiler wholly unbalanced. To brace the sides of the boilers, then, it is necessary to tie them across above and below the flues by heavy tie rods, and as this leaves the flat side for more than the depth of the flue unsupported, that side must be stiffened by a heavy vertical bar of wrought iron fastened to the side at the usual intervals for braces by lugs. These vertical bars are placed lengthways the boilers at the usual intervals for braces, and the heavy tie rods are fastened to the bars at top and bottom, unless the flues descend to nearly the bottom of the boiler, when that bottom becomes itself the tie rod. Of course, each pair of these rods must be sufficiently strong to sustain the pressure on the whole surface comprised longitudinally between the centres of the vertical bars and vertically between the centres of the tie rods. The system is shown in fig. 3.

Trial Trip.—On the 30th December, 1852, an engineer's trial trip was made from the Navy Yard at Washington down the Potomac river to Fort Washington and back. The Hon. Mr. Kennedy, Secretary of the Navy, and Commodore Shubrick, Chief of the Bureau of Construction, with a number of other gentlemen, were on board. The time occupied in running between the given points was accurately noted. The brick work of the boiler was as shown in fig. 1; the 7 inches high brick wall being under the hanging bridge, and the brick work in the top part of the front end of the flues being 22 inches *down.* The hinged hanging plate marked 6 inches, and depending below the hanging water bridge, was not on. The water was perfectly smooth. In running from the Navy Yard to the Fort, the tide, which is here without much influence at the strongest, was at the flood; the gentle southerly breezes were unfavorable. On the return, the tide was ebbing fast, but the same breezes as before were now favorable. The distance from the Arsenal (1½ miles below the Navy Yard) to the Fort and back to the Arsenal, including turning, traversed by the vessel, is 21 miles. Time occupied in running it, 110 minutes; mean draft of the vessel 7¼ feet; immersion of the lower edge of the paddle, 2 feet 11 inches. The consumption of coal was ascertained by careful measurement. The speed as given by the *chip log* was large 9½ knots per hour, or 10·944 statute miles. It is well known that when the speed of a vessel exceeds 8 knots per hour, the indications of the chip log become too low.

Speed of vessel in statute miles per hour, . . .	11·4545
Revolutions of the wheels per minute, ...	25
Slip of the centre of pressure of the paddles in per cents. of its speed,	24·63
Initial steam pressure in cylinder per square inch above atmosphere, by indicator, ...	18 pounds.
Steam cut off at from commencement of stroke of piston,	·36 or 2 feet 2 inches.
Consumption of Lackawanna anthracite per hour, . .	666 pounds.
Pounds of steam evaporated per hour from fresh water, with temperature of feed water 100° Fahr., by one sq. foot of heating surface,	2·429
Pounds of steam evaporated per hour from fresh water, with temperature of feed water 100° Fahr., by one pound of coal, .	6·252
Cubic feet of steam of atmospheric pressure furnished per minute. from fresh water, with temperature of feed water 100° Fahr.,	1919·521
Pounds of coal burned per hour per square foot of heating surface,	0·383
" " " " " grate surface,	10·918
Mean effective pressure on piston per square inch, by indicator,	19·4 pounds.
Horses power developed by the engines, . .	194·78

Trip from Washington to Baltimore.—On this trip, the brick work of the boiler was as shown in the large engraving. The vessel drew 9 feet 5 inches forward and 8 feet 5 inches aft; mean draft 8 feet 11 inches, having 120 tons of Lackawanna anthracite on board, with full stores, &c. Immersion of lower edge of paddles, 4 feet 7 inches. The vessel was very badly trimmed, being a foot by the head. Left the Arsenal on the 15th January, 1853, at 7 hours 5 minutes, A. M., and steaming down the Potomac river, was abreast of Point Lookout at 7 hours 56 minutes P. M., the same day. Time 12 hs. and 51 m., from which there is to be deducted 1 hour and 10 minutes for stoppages to repack cut-off dash ports, leaving the running time 11 hours and 41 minutes. Distance by Chart 102 statute miles; smooth water and light fair winds. No *blowing off* done.

RESULT.

Speed of vessel in statute miles per hour, . . .	8·730
Revolutions of the wheels per minute, (by counter,) . .	18·264
Slip of the centre of pressure of the paddles in per cents. of its speed,	21·38
Initial steam pressure in cylinder per square inch above atmosphere by indicator, ...	11·3 pounds.
Steam cut off at from commencement of stroke of piston,	·62 or 3 feet 8⅜ inches.
Consumption of Lackawanna anthracite per hour, . .	631 pounds.
Pounds of steam evaporated per hour from fresh water, with temperature of feed water 100° Fahr., by one sq. foot of heating surface,	2·240 "
Pounds of steam evaporated per hour from fresh water, with temperature of feed water 100° Fahr., by one pound of coal, .	6·500 "
Cubic feet of steam of atmospheric pressure furnished per minute from fresh water with temperature of feed water 100° Fahr., .	1859·222
Pounds of coal burned per hour per square foot of heating surface,	0·345
" " " " " grate surface,	10·344
Mean effective pressure on piston per square inch, by indicator,	18·5 pounds.
Horses power developed by the engine, . . .	135·69

After rounding Point Lookout, the *Water Witch* proceeded up Chesapeake

Bay to Baltimore, against about half a gale of wind and considerable sea, and at 9 hours 50 minutes A. M., January 16th, stopped the engines and anchored in Baltimore harbor; distance from Point Lookout, 97 statute miles; time, 13 hours 54 minutes. During this half of the trip steam was carried as high as possible, and the performance of the boilers may be considered their maximum. No *blowing off* done.

RESULT.

Speed of the vessel in statute miles per hour, . . .	6·978
Revolutions of the wheels per minute, (by counter,) . .	18·508
Slip of the centre of pressure of the paddles in per cents. of their speed,	37·98
Initial steam pressure in cylinder per square inch above atmosphere, by indicator, ...	22·3 pounds.
Steam cut off at from commencement of stroke of piston,	·59 or 3 feet 6½ inches.
Consumption of Lackawanna anthracite per hour, . .	909 pounds.
Pounds of steam evaporated per hour, from brackish water, with temperature of feed water 100° Fahr., by one square foot of heating surface, ...	2·995 “
Pounds of steam evaporated per hour, from brackish water, with temperature of feed water 100° Fahr., by one pound of coal,	6·033 “
Cubic feet of steam of atmospheric pressure furnished per minute, from brackish water, with temperature of feed water 100° Fahr.,	2486·080
Pounds of coal burned per hour, per square foot of heating surface,	0·497
“ “ “ “ “ grate surface,	14·902
Mean effective pressure on piston per square inch by indicator,	25·7 pounds.
Horses power developed by the engine, ...	191·02

Trip from Baltimore to Norfolk.—On the arrival of the *Water Witch* at Baltimore, the grates were altered so as to be 7 feet instead of 6 feet long. This alteration involved no others, and the rest of the boilers remained as before. This change made the grate surface 71 square feet instead of 61 square feet. The vessel left Baltimore on the 19th Jan., 1853, at 11 hours 45 minutes, A. M., and anchored off the Navy Yard, Norfolk, at 7 o'clock A. M., Jan. 20th. On the passage several stoppages occurred from causes not connected with the machinery, involving a loss of one hour and a quarter, making the running time 18 hours. Distance by Chart, 190 statute miles; moderate wind and sea on the port quarter, but no sail set. The counter being out of order, the revolutions of the wheels were noted at regular intervals by the watch. Draft of vessel, 8 feet 9 inches forward, and 8 feet 10 inches aft; immersion of lower edge of paddles, 4 feet 5½ inches. No *blowing off* done.

RESULT.

Speed of the vessel in statute miles per hour, . .	10·556
Revolutions of the wheels per minute, ...	22·4
Slip of the centre of pressure of the paddles in per centums of their speed, ...	22·48
Initial steam pressure in cylinder per square inch above atmosphere,	18·3 pounds.
Steam cut off at from commencement of stroke of piston,	·6 or 3 feet 7¼ inches.
Cousumption of Lackawanna anthracite per hour, . .	1090 pounds.
Pounds of steam evaporated per hour, from bay water, with the temperature of feed water 100° Fahr., by one square foot of heating surface, ...	3·313 pounds.
Pounds of water evaporated per hour, from bay water, with temperature of feed water 100° Fahr., by one pound of coal, . .	5·566 “
Cubic feet of steam of atmospheric pressure furnished per minute, from bay water, with temperature of feed water 100° Fahr.,	2750·26
Pounds of coal burned per hour per square foot of heating surface,	0·595
“ “ “ “ grate surface,	15·352
Mean effective pressure on piston, per square inch, . .	23·1
Horses power developed by the engine, . . .	207·8

During the above trip the heat in the lower part of the smoke chimney was sufficiently great to burn off the paint.

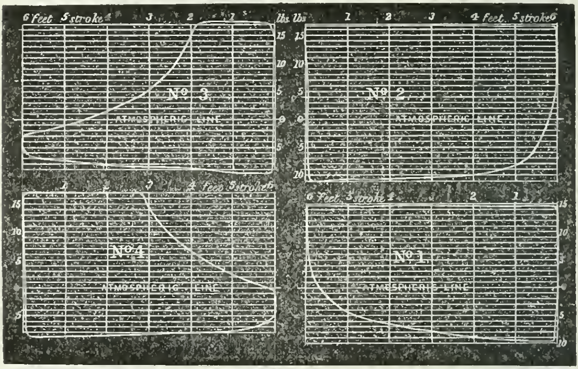
For the sake of ready comparison, I have collected the results of the foregoing trips into one table, an examination of which will show the effect produced by the various modifications of the boilers, and by the different drafts of vessel, immersion of paddles, &c.

Table of Results.

	Trial trip from Arsenal to Fort Washington and back.	Trip from Washington to Point Lookout.	Trip from Point Lookout to Baltimore.	Trip from Baltimore to Norfolk.
Speed of the vessel in statute miles per hour,	11·4545	8·73	6·978	10·556
Revolutions of the wheels per minute,	25	18·264	18·508	22·4
Slip of the centre of pres. of the paddles per cent,	24·63	21·38	37·98	22·48
Initial steam pres. in cyl. per sq. in. above atmo.,	18	11·3	22·3	18·3
Steam cut off at from commencement of stroke,	2 ft. 2 in.	3 ft. 8⅜ in.	3 ft. 6½ in.	3 ft. 7¼ in.
Consump. of Lackawanna anthracite per hour,	666	631	909	1090
Pounds of steam evaporated per hour, with temperature of feed water 100° Fahr. by one sq. foot of heating surface, . . .	2·429	2·240	2·995	3·313
Pounds of steam evaporated per hour, with temperature of feed water 100° Fahr., by one pound of coal, ...	6·352	6·500	6·033	5·566
Cubic feet of steam of atmospheric pressure furnished per minute, with temperature of feed water 100° Fahr., ...	1919·521	1859·222	2486·080	2750·26
Pounds of coal burned per hour per square foot of heating surface, ...	0·363	0·345	0·497	0·595
Pounds of coal burned per hour per square foot of grate surface, ...	10·918	10·344	14·902	15·352
Mean effective pressure on piston per sq. in.,	19·4	18·5	25·7	23·1
Horses power developed by the engine, .	194·78	135·69	191·02	207·8
Mean draft of vessel, ...	7 ft. 3 in.	8 ft. 11 in.	8 ft. 10 in.	8 ft. 9 in.
Immersion of lower edge of paddles, .	2 ft. 11 in.	4 ft. 7 in.	4 ft. 6 in.	4 ft. 5½ in.
Immersed amidship section in square feet,	136	174·3	172·4	170·5
Displacement in tons of 2240 pounds, .	407·4	529·2	522·08	517·0
Condition of water, ...	Smooth.	Smooth.	Head sea.	Md. on qr.
Condition of wind, ...	Gentle breeze.	Light fair wind	Half gale ahead.	Mod. on qr.; no sail set.

From the foregoing results it will be perceived that these boilers only gave an average performance, and the reason must be looked for principally in the cross area of the flue, compared with its length and surface. The heated gases passed out before their temperature was sufficiently reduced, and they were not brought in contact with the heat absorbing surfaces for the proper length ot time. The thickness of the flue iron was a scant quarter of an inch; that of the other heat absorbing surface, $\frac{3}{16}$ths of an inch. The flues were also too deep, probably 21 inches too deep, for the gases to diffuse over, and the main current of hot gas, and consequently, the principal heating portion of the flues, were to a great extent comprised between the dotted lines in the large engraving. The net cost of the boilers complete, was 13½ cents per pound.

By an examination of the table of results, it will be perceived that just in proportion as a greater amount of coal was burned, the evaporative result decreased. But the maximum amount burned per square foot of grate surface per hour, was only 15·352 pounds, with a proportion of heating to grate surface of 25·8 to 1·0, a proportion larger than sufficient to absorb the heat generated, had it been brought in contact with it; consequently, had all the heat absorbing surface been effective, the evaporation with anthracite would have been as high economically with the combustion of 1090 pounds, as with that of 631 pounds; but if the effective heat absorbing surface be considered greatly reduced, it is plain why the combustion of a less amount of coal in the same time should give a higher result.



During the preceding trips, there was always a great amount of back pressure in the condenser, owing principally to the arrangement of the air pump, which was inclined, and had a solid piston. The engine never made what is called "a good vacuum." The indicator cards show the condition of the valves; Nos. 1 and 2 were taken in quick succession from the top and bottom of the cylinder, working full stroke at the Dock; revolutions of the wheels, 11 per minute. Nos. 3 and 4 were similarly taken during the trial trip, the cut-off remaining the same in both; revolutions of the wheels, 26 per minute.

On the Arrangement of the Materials in the Blast Furnace, and the Application of the Waste Gases. By Mr. Samuel H. Blackwell.*

The use of the waste gases given off from the top of the blast furnace, has been long known and adopted in many of the Continental iron works. The higher cost of fuel, and the greater attention paid to a scientific knowledge of the most important process of manufacture, led to the use of the waste gases of the blast furnace in the works of France and Germany, long before their application here. The United States soon followed the example of the Continent; and in the iron works of Pennsylvania, for some years past, the use of the waste gases has been general. The object of this paper is to point out some of the causes which have prevented their more general use in England in our great iron works, and to call attention to some light thrown, by the attempts to use them, upon the best arrangement of the materials in the furnace.

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* From the London Journal of Arts and Sciences, January 1853.

The first attempt to apply the gases in our iron works was made at Ystal-y-Fera, in South Wales, by Mr. Budd, who obtained a patent for their use.

The method of employing them was at first defective, from the direct flame of the furnace being taken off instead of the gases themselves. The moment the gases emerge from the top of the furnace, and unite with the atmosphere, ignition takes place; and if the flame is to be economized, it must be immediately applied to the surface upon which it is to act, or its heating power is given off and consequently wasted. The attempt therefore to apply flame, necessitated the erection of the boilers, or of the pipes in which the blast was to be heated, in immediate contiguity with the tunnel head. In many works this was a matter of great difficulty, and in very few could it be done without inconvenience. Even where practicable, the flame always acted powerfully upon the passages through which it passed, and exhausted itself, in proportion to their length and absorbing powers, before it became available at the points where it was really required. This difficulty led to such an alteration in the arrangements adopted, that instead of the flame, the gases themselves could be drawn off from the materials in the furnace, before they had become ignited by mixing with air. For this purpose a cylinder of cast or wrought iron, resting by a broad flanch upon the upper part of the lining of the furnace, was carried down into the interior of the furnace to a depth of several feet beneath the top of a horizontal pipe, through which the gases passed off. The diameter of the furnace expanding from the top downwards, an open space was thus enclosed between the inside wall of the furnace and the cylinder, forming a reservoir for the gas, into which as long as the cylinder was kept full, no air from above could enter.

This arrangement perfectly answered its purpose, as far as taking off the gases unignited; and although they still passed off at a high temperature, the loss of heat in the passages was much diminished, being confined to simple radiation from the hot but unignited gas: however far it was carried, its chemical nature remained unchanged, and atmospheric air was allowed to mix with it only on its reaching the point where the heat given off in its combustion became available. All difficulty in placing either the pipes for heating the blast or the boilers was thus obviated; but there remained two sources of inconvenience. First, a very powerful draft was required to be given by a sufficient height of stack to draw off the gases with regularity; and second, the entire quantity which it was possible to draw off, under the most favorable circumstances, bore only a small proportion to the entire quantity generated in the furnace—the greater part of which still escaped through the open cylinder.

Where a powerful stack was at hand, and where it was not a matter of importance to economize the entire amount of gas generated, this arrangement was in many instances satisfactory. It was not, however, always so; in many works it was found impossible to get the furnaces to work well after the gases were taken off; great fretting of the tuyeres, accompanied by frequent scaffolding and slipping in the furnace, was constantly producing irregularity in its working;—the quantity made would thus be much decreased; and, after much annoyance, the attempt to use the gases was in such cases generally abandoned, as productive of more inconvenience and loss than economy. This was much more the case in South Staffordshire than in Wales. In the former district it led, after three or four trials, all with the same result, to its complete abandonment. It was difficult to understand the cause of this great irregularity in the results obtained, which at first seemed inexplicable; but this cause is now believed to be fully understood.

In the year 1849, two furnaces in Derbyshire were placed in the writer's hands, from which the gases were taken off for the purposes of heating the blast. The furnace worked with considerable regularity whenever the heat could be properly mantained, but this was not constantly the case, in consequence of the opening into the gas flues being situated so near the top of the furnace that, when the wind was in certain directions, the gas did not pass off with regularity, or if it came off in sufficient quantity, it was so mixed with atmospheric air that it burned down the passages, and thus occasioned great inconvenience. The writer determined upon obviating this by covering the opening into the gas flue with a wrought iron cylinder. The tops of the furnaces were small, and only admitted by cylinders of the respective sizes of 4½ feet and 6 feet being employed. This effect was perfectly satisfactory, in enabling a regular supply of unignited gas to be obtained; but the furnace with the 4½-feet cylinder began to scaffold and slip; the tuyeres were exceedingly troublesome; and the weekly make fell off considerably. After a trial of one or two weeks, the cylinder was taken out, other means were adopted to prevent the gas taken off from becoming ignited, and the furnace again resumed its former regularity. The furnace into which the 6-feet cylinder had been placed, worked far better, but not quite satisfactorily; and upon the cylinder burning out, it was not replaced,—arrangements being made similar to those adopted in the other furnace. It will not be necessary to describe these arrangements, as arrangements similar in principle, but improved by subsequent experience, will be afterwards described. Both furnaces have worked ever since satisfactorily, and the gases taken off furnish all the heat required for heating the blast,—no slack whatever having been used for some years for the purpose.

It was evident from this trial, and from similar results at other works, that the irregularity did not arise from the mere abstraction of the gases themselves; and there was only one other cause to which it could be attributed, viz: the narrowing of the filling part of the furnace; and the question then arose, in what way did this operate? The first suggestion that presented itself was naturally that the effect produced arose from decreasing the area through which the gases generated in the furnace were given off, and thus causing greater obstruction to the free passage of the blast. The explanation was soon found to be untenable.

The saving effected in some of the Welsh works by the use of such portion of the gases as could be economized by the use of the cylinders employed there, led to a wish to make the entire quantity of gas generated available, by closing the top of the furnace, and not allowing any gas to escape into the open air. This was first effected by Mr. Levick, at the Cwm Celyn Works. In the arrangement adopted by him, two cast iron bearers extend horizontally across the furnace, at a depth of about seven feet below the top; and upon these a cone of cast iron is placed,—the base of the cone being less than the diameter of the furnace. A short cylinder about three feet and a half deep is suspended from the filling plate, resting by a flanch (as in the case of the cylinders previously described) upon the lining of the furnace; and a second cylinder of about the same depth rests upon the base of the cone. This second cylinder is larger than the first, and being movable around it, can be lifted by means of two bars of iron or chains, attached to it, and passing through openings made for the purpose in the flanch of the upper cylinder. The pipe for the passage of the gases extends horizontally from the upper part of the interior of the furnace. When the lower cylinder rests upon the cone, the top of the furnace is closed in entirely, and the space inside the two cylinders can be filled with the materials constituting the charge. Upon lifting the lower cylinder, the charge immediately falls into the furnace round the base of the cone; and the cylinder being again lowered, the top is once more closed in.

Another arrangement for effecting the same object, was soon afterwards adopted at the Ebbw Vale works. In this arrangement an inverted and truncated hollow cone is fixed in the top of the furnace,—resting on the lining by a flanch, similar to those employed to suspend the cylinders. The truncated end is closed by another cone, the apex of which ascends through it; and this closing cone is suspended by a chain, passing over a pulley, by which it can be lowered or raised at pleasure. On the lower cone being raised, the furnace is closed, and the materials wheeled into the upper cone; and when the movable cone is lowered again, the materials at once drop into the furnace. This arrangement is now in full operation, and working satisfactorily at several of the works belonging to the Ebbw Vale Company. Both at these works, and also at the Cwm Celyn Works, the furnaces with the closed tops work well; they carry equal, if not better burdens than those which are open; they work with equal regularity, and make an equal quantity of iron. The area through which the gases are taken off is in some cases not equal to that of a 3-feet pipe, and much less than that of the smallest of the cylinders which produced such unfavorable results. Consequently, the injurious action of these cylinders could not arise from the decreased vent permitted to the gases, nor to any obstruction in the blast. The only other way in which the cylinders could produce any effect would be by causing the materials filled into the furnace to fall too much towards the centre of the furnace,—thus producing an arrangement of them, which in some way acts prejudicially upon its general working. By the action of the cones, the materials wheeled into the closed furnaces are scattered round the side of the furnace, and are thus arranged as they would be in open furnaces with wide tops. It thus became at once obvious that cylinders in Wales had been productive of less injurious consequences to the general working of the furnace than those in Staffordshire, because the greater width of the Welsh tops had permitted cylinders of from 8 to 10 feet to be employed, whilst in Staffordshire only cylinders of much less size were practicable.

The important effect produced on the working of the furnace, chiefly by an alteration in the arrangement of the materials in the furnace, is a point of considerable interest, but one to which little attention has been hitherto paid. In practice it has been long known to the best managers of furnaces, that wide tops were desirable, and generally accompanied by increased make; but the precise manner in which wide tops acted was not clearly known until the attempt to use the waste gases led to its evident explanation. On the Continent, the importance of such arrangement of materials as would facilitate the passage of the blast, as nearly towards the centre of the furnace as practicable, has been known for some time and acted upon; and the writer was much pleased to find from M. Tunner, Professor of Metallurgy, in Austria, and connected with the Styrian Iron Works, that great increase of make had followed the adoption of wide tops to the charcoal furnaces of that district, combined with a method of filling, by which the coke or charcoal was placed in the centre of the furnace, and the ore and limestone around the sides.

Some few months back a furnace was placed in the writer's hands, which he found provided with a cylinder and other arrangements for taking off the gases. Although apprehensive that the cylinder would materially interfere with the working of the furnace, yet, as everything was arranged for it, and as it was six feet in diameter, he determined to blow it in without alteration. This was done—the expected result following, —constant slipping, and fretting tuyeres, with all their attendant bad results. The stacks were not powerful enough to draw off the gases, unless a closed top was used; and the writer therefore adopted an arrangement somewhat similar to the Ebbw Vale one. The result was immediate; the furnace worked with great regularity, and carried a good burden; but white iron alone was produced. The burden was lightened, but the iron remained white. A farther lightening of the burden was made; but although the cinder was exceedingly gray, still the iron was white. It became evident that a greater proportion of coke would not produce the desired change, and was in fact useless. The white iron was evidently the effect of the closed top. A pipe of nine inches diameter was inserted at the filling place, but with no effect. Another pipe was inserted, and some little change appeared.

It being important to produce gray iron, it was now determined to sacrifice the use of the gases entirely, rather than continue to make white iron. A lid or valve upon the main gas-pipe, and a covering on the top of an auxiliary gas-pipe were now opened to the atmosphere, and a decided change was at once evident. The iron became gray and the furnace worked with regularity. The white iron had evidently been caused by the pressure produced by the closed top; and so extremely sensitive did the furnace appear to be to the slightest restraint, upon the free passage of the gases, that even a strong wind blowing into the open box, through which the gases were principally escaping, would throw the furnace back to white iron.

In Wales, where the closed tops are successfully employed, the production of white iron is rather sought for, and hence the tendency in closed tops to produce that quality is no disadvantage. In many cases, however, it must be a fatal objection to their use. But for this objection closed tops would become universal; as they entirely do away with the necessity for a lofty stack, and enable all the gases to be economized. That the tendency to produce white iron has no connexion with the mere abstraction of the gases from the furnace is clearly shown by the results of the Scotch furnaces, in which they are taken off without employing closed tops. At Dundyvan, especially, great attention has been paid to this point; and the result has been shown to be that the furnaces from which the gases are taken, work with equal regularity, and produce gray iron with equal facility to those from which the gases are not taken; and it would be easy to multiply instances of the same result.

To be Continued.

For the Journal of the Franklin Institute.

On the Analysis of Cast Iron. By Professors Campbell Morfit and James C. Booth.

(Extract from the Official Report to Captain L. A. B. Walbach, U. S. Ordnance, on Foundry Service, upon the Examination of Gun Metal.)

The associated substances always occurring with the ores, in the furnace, are silica, lime, and alumina; in addition to which, sulphur, phosphoric acid, oxide of manganese, magnesia, and the alkalies are rarely absent. Substances of more unusual occurrence are oxides of chronium, tin, titanium, vanadium, copper, arsenic, and some others. Now, although most of these substances are reduced to their metallic state with great difficulty, by the fuel and high heat of the furnace, yet their affinity for oxygen is weakened, and the contact of a large quantity of metallic iron adds its influence to reduce portions of them to metal, in which state they enter into combination or admixture with the iron. Hence crude cast iron or pig iron, besides its essential constituent carbon, contains more or less of the elements of the ingredients above named, though always in small proportion to the iron, and, in their total amount, rarely exceeding eight to ten per cent.

The influence of these associates upon the character and influence of cast iron has been determined to a limited extent, and in the case of only a few of them. Thus, a considerable proportion of manganese is said to impart a large lamellar and brilliant fracture and some degree of brittleness; phosphorus is supposed to render iron "*cold short*," and sulphur, "*hot short*." But the full extent of influence of these few is yet undecided; while the influence of most others is either unknown or at least subject to great doubt.

Although most of the above are only occasional constituents, and exist, when present, only in minute quantities, still it was expedient that the examination should be made with a view to the detection of each and every one of them.

Pulverization.—It was found, after repeated trials, that the only sure way of obtaining samples of uniform composition was to clip off pieces of the size of $\frac{1}{8}$th to $\frac{1}{10}$th of an inch diameter, by means of a cold chisel and hammer. These were taken from the small broken cylinders, which had been bored from the muzzle of the gun, and had served for the mechanical tests. Reduction under the pestle and sifting should be avoided; for any process, which requires that the metal shall be acted upon in a state of *powder*, is defective; because the slag and graphitic carbon being, as it were, mere mechanical components pervading the mass of iron and not chemically combined with it, form finer particles by pulverization, which from their low specific gravity fly off partly as dust. This loss and the difficulty of reducing the metallic granules to the same state of fineness as the siliciuretted and carburetted constituents of this metal, prevent the possibility of obtaining a mixture sufficiently uniform to afford a fair average sample. We found that equal portions of the same powder gave under the same circumstances variable results, whatever solvent was employed. Thus one gramme digested in nitro-muriatic acid, gave of insoluble residue, in two sets of experiments similarly conducted:—

Total Insoluble Residue.

	1.	2.
Sample, *a*,	·0456	·0486
b,	·0480	·0682
c,	·0436	·0568
d,	·0460	·0612

These were selected indiscriminately from more than twenty experiments, all of which yielded results that are equally conclusive. In several trials, the proportion of insoluble residue obtained from the samples of *dusty* metal, presented a greater variation than those from the clippings or even the fine granules. The discrepancy arises from the facts just mentioned. It is also because the mixed metal, in its finest state of comminution, is peculiarly sensitive to a decomposing or transforming action of the digesting liquids, which, instead of being confined solely to effecting solution of the metallic bases, extends to the transmutation of some of the other constituents into soluble matter, as will be treated in the paragraphs relating to the estimation of carbon, slag, and silicium. It is therefore imperative that, first, in reducing the metal mechanically, it must be to clippings, and not to powder. The size should be from $\frac{1}{8}$th to $\frac{1}{10}$th of an inch diameter, as this bulk is better adapted to insure a gradual reaction and uniformly exact results.

Total Amount of Carbon.—The important bearing of this ingredient upon the quality of cast iron renders its accurate estimation of paramount importance; for the metal is classified into *gray* and *white* varieties, according to the condition in which the carbon exists in it. For instance, in gray iron there is both combined and free (graphitic) carbon; while in the white the carbon is wholly or nearly all combined with the metal. Now, as the only way of accurately determining the former condition is by deducting the graphitic from the totality of carbon, it is essentially important, that these last two should be estimated with great precision. The most usual method of determining the whole of the carbon is to ignite five grammes of the finely powdered metal, in a combustion tube, with a mixture of anhydrous chromate of lead and chlorate of potassa, or with oxide of copper. By the aid of high heat and the oxygen generated by the decomposition of those highly oxydizing bodies, the carbon burns off as carbonic acid, and is condensed by caustic potassa contained in a bulbed receiver. The increase of weight which the latter acquires by the process of combustion represents the amount of carbonic acid absorbed, whence the total amount of carbon is calculated. This plan, although expeditious, is liable to many objections; the chief of which is the necessity of having the metal in an impalpable powder, in order to effect its complete combustion. This entails the disadvantages enumerated in the paragraph upon PULVERIZATION. It will also be necessary, in most cases, to repeat the ignition in order to check doubtful results.

Another and very accurate method is that proposed by Berzelius, and which consists in depositing a weighed lump of five grammes of metal upon a fused cake of 30 to 40 grammes of chloride of silver, in a vessel containing water and closely covered to prevent access of air. A little hydrochloric acid is added to promote the action. The silver salt gradually decomposing, gives up its chlorine to the *bases* of the metallic iron, which by the union, become soluble in the water as chlorides, while the eliminated carbon, silicium, and slag subside to the bottom upon the silver cake, which is more or less reduced to the metallic state. The liquor being filtered off through a small paper, the undecomposed portion of chloride of silver is removed with a platinum pointed pincette, freed of adhering particles by means of the wash bottle, and reserved for use at another time. The contents of the filter, while still moist, are to be rinsed out into a beaker, treated with dilute nitric acid and gently warmed to dissolve the reduced silver powder and any traces of oxide of iron. Great care must be observed to provide against too much heat, so as to prevent portions of the carbon from being converted into soluble artificial tannin. When the whole of the silver and oxide of iron has been taken up, the liquor is filtered on a balanced filter, which is washed with hot water, dried first in a hot air chamber and finally in vacuo, and weighed. The gross amount of carbon, silica, and slag is thus obtained. By ignition the whole of the carbon is burned off, and the amount determined by weighing the calx. The difference between the two weights, which is the amount lost by the ignition, represents the carbon.

Solution of chloride of copper has been suggested as a substitute for the solid chloride of silver, and its action is more energetic and rapid; but the objection to the plan is, that a small portion of the carbon is lost as carbo-hydrogen gas.

The above plan has the advantage of giving the total carbon in one operation; but it is tedious, time consuming, and only manageable with difficulty. Ten to twenty days are necessary for the perfect completion of the operation; and if any air should accidentally enter the digesting vessel, the consequent formation of hydrated peroxide of iron is a serious impediment to the progress of the reaction. The traces of hydrochloric acid, with which the water may be acidulated, tend to prevent the generation of this oxide, but it must be used sparingly, since, otherwise, by taking up some of the metalic iron, a part of the carbon might be driven off. Free chlorine has also been proposed by Berzelius, but its use is less practicable than the preceding method; because bulbed glass apparatus, requiring nice arrangement and careful management, must be employed by his mode. There is, moreover, difficulty in volatilizing all the chloride of iron formed, and also in preventing the access of air, which by its oxygen, will convert some of the carbon into carbonic acid or oxide, or both.

Another process by the same distinguished chemist consists in subjecting the iron in filings to the spontaneous action of dilute but perfectly pure nitric acid added portionwise. It is time consuming, and requires great attention to insure uniform reaction; for much heat is eliminated, and may raise the temperature of the mixture above 125° Fahr., and thus promote the transformation of a portion of the carbon into soluble matter, as mentioned in the paragraph relating to graphitic carbon. Moreover, a basic salt of iron, soluble with difficulty in cold acid, is likely to be formed. Besides, if any of the foreign alloys are convertible into insoluble oxides by the nitric acid, they remain with the carbon and silicium; and in the after-separation of the former from the latter, by ignition, they may by entire or partial volatilization with the carbon, lead to error in its estimation.

Berthier's process of estimating the total amount of carbon, by slowly oxidizing the iron by exposing it to the air and moisture, is tedious and tends to error, from the fact, that the hydrochloric acid required in the after part of the operation, to dissolve out oxide of iron, as well as the subsequent evaporation to dryness to render the silica, &c., insoluble, subjects the carbon to a partial conversion into soluble humus.

After repeated trials and due consideration of the above and other processes for estimating the total amount of carbon, we were convinced that none of them possessed that union of speed and accuracy which is necessary to a satisfactory performance of the analysis. We therefore abandoned them, and proceeded to a course of experiment, with the view of elaborating a process which would be rapid as well as reliable; and succeeded in developing the following method.

2d. One gramme of metal clippings, having been accurately weighed, is placed in a small beaker with the atomic proportion of iodine, say, 5 grammes of iodine to one of metal; a little water is added, and the glass with its cover on, left at rest in the cold. Five to six hours suffice for completing the solution of the bases; and the rapidity of action is inversely as the state of dilution of the liquid, so that only enough of water to cover the mixture should be employed. Perfect solution is recognised in the dark brown liquid by the flocculent character of the insoluble matter, as compared with the heavier and metallic particles; and if any of the latter still remain unacted upon, they will subside heavily to the bottom. In such case, a few more grains of iodine must be added, if the first portion has entirely dissolved, and the digestion arrested by filtration, as soon as the solution of the metal has been accomplished, for a prolonged action of the iodine, as well as too great dilution promote the oxidation and volatilization of the carbon.

Great care must be observed to temper the reaction, which, when violent, gives off a distinct odor analogous to that of chloride of sulphur. *Slight* additions of water, therefore, become occasionally necessary, for undue warmth is apt to induce the conversion of a portion of the carbon into soluble matter. This reaction is particularly evident when the metal is in very fine powder. Water is probably decomposed, the oxygen going to the carbon and iron, and the hydrogen to the iodine, which then, in its compounded hydriodic acid form, unites with the oxide of iron.

For example, we present a few results, selected indiscriminately from many equally conclusive, which not only show the difference between the digestions with iodine at hot and cold temperatures, but also the inequality of the "hot carbon," results owing to the difficulty of so regulating the heat as to produce uniformity of reaction.

	Clippings digested with Iodine in the cold. Total Carbon.	*Powdered metal digested with Iodine on the sand bath.* Total Carbon.	
	1	1	2
No. *m*,	·046	·037	
No. *n*,	·039	·024	
No. *k*,	·038	·028	
No. *p*,	·045	·022	
No. *e*,	·042	·0085	·024
No. *f*,	·044	·034	
No. *s*,	·026	·016	
No. *h*,	·033	·029	·0285
No. *j*,	·039	·0255	·0380
No. *c*,	·034	·016	·0255

When it is evident that no fine particles of metal remain at the bottom of the beaker, the solution is perfect, and the insoluble matters, consisting of all of the carbon, slag, some silica, and a portion of oxide of iron, formed as mentioned under "slag and silicium," float in the liquid, which contains the bases or remaining constituents as iodides. The solution is to be immediately diluted with water, filtered through a balanced filter, washed with hot water, then with hydrochloric acid to remove traces of sesqui-oxide of iron, and finally with hot water. The filter is then first dried between the folds of bibulous paper, and subsequently in vacuo, along with the counterpoised paper. The two are then weighed against each other, and the difference of weight denotes the amount of insoluble residue. As this latter does not consist wholly of carbon, but also contains slag and some silex and perhaps alumina, the filter must be transferred to a platinum crucible, cautiously ignited over a lamp, and finally by the blast, until every particle of carbon is burned off, as may be known when the residual calx presents no black specks, and again weighed. The loss by ignition represents the total amount of carbon contained in the iron, and is to be determined by deducting the weight of the calx from the weight of the calx and carbon combined.

The filtrate is rejected, because of the large excess of iodine which it contains, as the evaporation to dryness with hydrochloric acid requisite for its expulsion, would so diminish the phosphoric acid as to render its estimation from such a solution inaccurate.

Allotropic or Graphitic Carbon.—We have already stated that the carbon in cast iron may exist in two conditions, combined and free; in the latter or free state it is usually termed graphitic carbon, from its identity with native graphite or plumbago, possessing the same chemical composition, viz: being essentially pure carbon, and the same external character of scaly structure, color, greasy feel, and softness. Regarding the diamond as one form of pure carbon and graphite as another, they have been termed allotropic conditions of that element, and hence in speaking of the graphitic variety, we have termed it allotropic.

White cast iron contains all the carbon in a state of combination if it be rapidly cooled after fusion; but by slower cooling, a portion of the carbon is eliminated or precipitated through the mass, in the form of graphite, the black scales of which contrasting with the whiter color of the metal, give the appearance of *gray* iron. Where the precipitation takes place only in spots, the metal is termed *mottled.* This artificial graphite is equally resistant of chemical agents as the native plumbago, and since the combined carbon when separated from cast iron by chemical agency is easily acted upon, we availed ourselves of their different behavior to determine their relative quantities. In our first essays we followed the method of Karsten for estimating the allotropic carbon, because it had the sanction of high authority; but we found by experience that it is unsatisfactory. The process consists in dissolving a given weight of the powdered metal in nitric acid, by gentle heat, adding a little hydrochloric acid towards the end of the digestion, to ensure the solution of any undecomposed silicide, oxide, or phosphide not wholly soluble in single acids, and to prevent the formation of insoluble sub-nitrates, which are apt to be generated when nitric acid alone is used. After perfect solution, the whole is passed through a balanced filter, washed with hot caustic potassa solution to remove extractive matter, then with hot water and hydrochloric acid, and again with hot water. The filter, after being dried between paper and in vacuo, with its counterpoise, is weighed against the latter. The difference between the two expresses, quantitatively, the contents of the filter, which consist of carbon, slag, and some little perhaps of silica. They are separated by transferring the filter to a platinum crucible, igniting, and reweighing. The calx remains, but the carbon is burned off, and the loss in weight indicates its amount.

It is so very difficult to regulate the action of the nitric acid, that inequality of results is unavoidable. For example, carbon is variably sensitive to the action of nitric acid, according to its strength and the temperature. At the moment of elimination, it is in an impalpable state, which is peculiarly conducive to chemical action. Nor is this behavior confined solely to the combined carbon, for under the unavoidable circumstances of the digestion, the allotropic carbon is likewise altered, as is proved by the few following examples, selected from a series. Allotropic carbon is particularly changed by the *prolonged* digestion which is necessary to effect perfect solution, and if *fuming* nitric acid is added to facilitate the reaction, complexity of the change is augmented, and an irremediable source of error created. The annexed results not only lack uniformity in the two series, but also show in the first, a much less proportion of allotropic carbon than really exists in the iron, as is confirmed by the results of a correct process, given on the succeeding page.

	Allotropic Carbon.	
	First Essay.	Second Essay.
No. *a*,	·0106	·0294
No. *b*,	·0150	·0350
No. *c*,	·0156	·0350
No. *d*,	·0160	·0314
No. *e*,	·0210	·0085

Even slight differences in temperature and strength of acid induce important changes; and after some thirty experiments with results like the preceding, we abandoned Karsten's process as erroneous in principle and fact, and consequently discarded the results obtained by it. The essays to which this disappointment led were more propitious, and ended in a modification of Brownie's process, which fulfils every requirement.

3d. The allotropic carbon is to be estimated by digesting one gramme of clippings of metal at a gentle heat, with hydrochloric acid of specific gravity 1·1. In a few hours, the soluble ingredients of the metal will have dissolved, leaving the carbon in flakes or lumps, along with some silica floating or suspended in the liquor. The sediment is to be collected upon a counterpoised filter, washed with hot solution of potassa of specific gravity 1·29, to remove humus and extractive, then with dilute hydrochloric acid, and finally with hot water. The last washing must be thorough, because if any alkaline chloride is retained, being volatile, it will mostly pass off with the carbon during ignition, and thus cause error in the determination of the latter. The filter is then dried, first between folds of paper and subsequently in vacuo, with its counterpoise; and the two are afterwards weighed against each other, and the difference in weight noted. It will be observed on examination, that the carbon is in scales, and remarkably free from dusty particles. The filter and contents are now to be transferred to a platinum crucible, ignited cautiously over a "Russia lamp," and weighed. The loss by ignition expresses the amount of allotropic carbon contained in the samples, and may be ascertained by weighing the calx and deducting its weight from the original weight of the filter and contents.

There are certain requisite precautions to secure the accuracy of this process. Great care must be observed, in the ignition, to burn off all the graphite, so that not even a black speck may be visible in the calx. All draft must likewise be prevented, for particles of the calx may be accidentally blown off, and error thus occasioned, since the loss would be estimated as loss by ignition, and the amount of graphite thus erroneously augmented.

In the reaction with the acid, it is designed to restrict the agency of the hydrochloric acid, as to the carbons, solely to the conversion of that which is in a combined condition into gaseous carbo-hydrogens and humus, which is easily soluble in a solution of caustic potassa. We have, however, found that it is necessary to limit its strength, in order to effect this change without simultaneously altering the allotropic carbon. For example, if the density of the acid is too great and the temperature too high, the results will be variable and unsatisfactory, as is proved by the following experiments:

	Allotropic Carbon. 1. Strong Acid.	2. Strong Acid.
No. *m*,	·0159	·0170
No. *o*,	·0110	·0042
No. *q*,	·0152	·0095
No. *r*,	·0181	.0138
No. *s*,	·0055	·0130

It is evident, therefore, that strong acid and a high temperature not only cause the entire transformation of the combined, but induce a partial alteration of the allotropic carbon; so that the results will be constantly varying according to the varying circumstances, and to the prolongation of the digestion. On the other hand, the acid must not be too dilute, nor the temperature too low, else the converse of the above will happen; and owing to deficient action, a portion of the combined carbon, instead of having passed off in gaseous and soluble forms, will remain in fine powder with the allotropic carbon, to contaminate it and hinder its correct estimation. A little experience and care will insure a well conducted manipulation, and consequently correct results.

Combined Carbon.—4th, The combined carbon is determined after the estimation of the TOTAL CARBON and the ALLOTROPIC CARBON, separately, by deducting the weight of the latter from that of the former; the difference expresses the amount of the combined carbon. As this method by subtraction is the only available one, it is therefore imperative to have correct figures in order to obtain accurate results.

Silicium and Slag.—Having believed that the silicium and slag, either conjointly or separately, were important constituents as influencing the quality of cast iron, our experiments for separating and estimating them were numerous and varied. The silicium is a chemical component of the iron, while the slag is a mechanical ingredient pervading its mass like the allotropic carbon. This slag also contains silicium, but as silica, and in combination with earthy bases and oxide of iron; hence in separating the silicium of the metal, it is necessary to avoid decomposing the slag at the same time, and thus taking up, also, a portion of its silica or bases.

The silicium exists originally in combination with the metal as silicide of iron, and becomes oxidized into silica during digestion with acid, &c. The slag is an accidental ingredient. It is therefore important to determine quantitatively these two conditions; a task not without difficulty, owing to a certain similarity in the behavior of silex and of slag, respectively, to the reagents necessarily employed as solvents.

It is necessary to digest a new portion of clippings for the estimation of these components. The filtrate from the digestion with iodine for TOTAL CARBON, as well as from that with hydrochloric acid for ALLOTROPIC CARBON, will not answer, for the following reasons:

In the iodine digestion at cold temperatures, all the iron is taken up, but a portion of the alumina as phosphate, and probably the lime and magnesia are left with the untouched carbons, silica and slag, so that these would not be correctly represented by the weight of the insoluble residue. In numerous essays, repeated for verification, the quantity of the so called slag and silex was invariably larger than that obtained with nitric or hydrochloric acid. Moreover, as it is difficult to prevent access of air, a small quantity of a basic salt is formed, which is not entirely removed by the hydrochloric acid used in the final digestion, but tends to unite with the silica during ignition, and form a silicate resembling slag, whereby the normal slag is contaminated. The aluminum, calcium, magnesium, and phosphorus are oxidized by the oxygen of the water in the presence of the iodine. The large amount of slag always obtained by the digestion with iodine, induced at first the belief that the oxide of iron associated with it was free, and had originally existed as such in the metal, and being an oxy-base, was not touched by the iodine, nor yet by the hydriodic acid formed, owing to a deficient quantity of the latter. This view was founded on the fact, that digestion in acids, especially the hydrochloric, which leaves no basic salt, always gave less slag.

Nor can the slag and silicium be estimated from the hydrochloric digestion for *allotropic* carbon, because the solution would in that case have to be evaporated to dryness before filtration, in order to render all the silica insoluble; a process which, by concentrating the acid and augmenting the temperature, might endanger the partial conversion of the carbon into soluble humus and extractive; besides, the strength of the acid for the gaseous transformation of the carbon would have to be necessarily so high, that it might decompose the slag. The only course is to take a new portion and treat it as follows.

5th, One gramme of clippings of metal having been accurately weighed, is to be placed in a wide mouth flask. A funnel and a drying tube filled with fused chloride of calcium are adapted to the flask by means of a tightly fitting cork, and an exit tube, drawn out to a fine opening at its extremity, is fitted in like manner to the farther end of the drying tube. Having made certain by actual examination of the tightness of the joints, chemically pure hydrochloric acid of specific gravity 1·06 is then poured into the flask through the funnel tube, and the flask slightly warmed to start the action; gases are soon generated, and after having passed over a sufficiently long time to expel all atmospheric air from the interior of the flask, a lighted taper is applied to the fine orifice of the exit tube, so as to ignite the issuing jet of arseniretted or mixed gas which is formed from the elements of the contents of the flask. The burning jet is projected against a piece of cold white porcelain. If after five minutes of uninterrupted combustion there is no adhesive tache formed upon the porcelain, it is evident that there is no arsenic, since this process detects less than $\frac{1}{500000}$th part of a grain of that metal, with certainty.

Great care must be observed with regard to the character of the tache, for phosphuretted and antimoniuretted hydrogen gases both give dark stains in a similar reaction; if it is not adhesive, no attention need be given to it, as it is merely a distillate of oily carbo-hydrogens or phosphorus sublimate. Moreover, if it is a long time in being generated, it may be estimated as a trace; but if it is large and distinct and prompt in appearing, then it must be quantitatively determined from the same sample as the sulphur, as hereinafter directed. This precaution about the tache is particularly necessary also for the reason that the odor of the phosphuretted hydrogen, as eliminated when iron is dissolved in hydrochloric acid, so nearly resembles that of the corresponding arsenic gas, as to be mistaken frequently for it. In the reaction the water is decomposed, its oxygen goes to the iron, which then unites with the acid; while its hydrogen in the nascent state joins with the eliminated arsenic, antimony, and phosphorus, and passes over in a gaseous inflammable state. The qualitative test for arsenic, at this stage of the process, is a convenient saving of the time and trouble of a separate digestion, and is no hindrance; for when the test is completed, the apparatus is to be taken apart, and the flask, covered with a watch glass, transferred to the ledge of the sand bath, and there left until the residue becomes flotant. Solution is then complete, and the liquid must be evaporated to dryness, redigested in very dilute hydrochloric acid, filtered, washed with hot water and hydrochloric acid, and lastly with hot water. After drying the filter, it is ignited in a platinum crucible over a "Russia" lamp to burn off carbon, and then weighed to ascertain the amount of residual calx which consists of silex and slag.

Care must be observed not to use acid stronger than specific gravity 1·06, or the slag will be attacked and its bases dissolved; nor must it be weaker, as it will cause loss of time in the digestion.

The insoluble portion on the filter must be invariably washed with hydrochloric acid, to remove any traces of iron or oxide that may remain accidentally, and which would afterwards add undue weight to the slag, for it is not removable by subsequent boiling with potassa solution.

Having obtained the silica and slag together, and accurately noted their united weight, they are transferred from the platinum crucible to a small silver capsule, and boiled for two minutes with a half fluid ounce of caustic potassa solution of 1·10, (specific gravity, 1·25, diluted with two volumes of water.) After sufficient repose for the subsidence of all suspended particles, which from their extreme fineness would otherwise pass through the paper, it is filtered on the finest paper, and washed with hot water until the filtrate leaves no stain when heated to dryness on a platinum spatula. Silica is dissolved, and the slag remains untouched.

Ley of greater density than above prescribed would decompose the slag by abstracting its silica, while a lesser strength would not take up all the free silica. Nor is carbonate of soda, even in dense solution, a good substitute, for although it may imperfectly dissolve silica while boiling, it cannot retain it on cooling, but drops it partly in a free state and partly as soluble silicate of soda. The strength before directed has been found by experiment to answer best; it takes up the silica while hot and retains it on cooling, but does not attack the slag.

After the filter has been washed and dried, it is ignited in a platinum crucible and weighed; the weight expresses the amount of slag, and this deducted from that of the silica and slag united, gives the proportion of soluble silica; whence its content of silicium is to be calculated.

To be Continued.

For the Journal of the Franklin Institute.

Models for Steamships—A Comparison of the Performance of the U. S. Steamships Susquehanna and Powhatan.

In the science of ship building, as at present understood, a variety of opinions exist respecting the proper form to be given to vessels propelled at high speeds by internal power, so as to combine the requisite displacement and stability with a minimum resistance. Of these conflicting theories, two of the principal and most opposed to each other, refer to the position in the length of a vessel, of the "dead flat" or amidship section, involving also that of the centre of displacement. According to one party, this centre of displacement and fullest lines should be forward, and the finest lines of the ship abaft, so as to give every facility for the easy return of the disturbed liquid to its original position, after the vessel has passed through it. By the other theory, the finest lines should be those which divide the water forward, and the centre of displacement, therefore, be abaft the centre of length. Without pretending to discuss or argue a question of such importance, we shall submit certain facts bearing upon it, which being well authenticated are worth more in forming a correct judgment, than all the unsupported opinions which have been or can be advanced upon the subject.

The United States steamers *Susquehanna* and *Powhatan* are vessels of the same dimensions of length, breadth, and beam, intended to carry the same weights, sparred precisely alike, and provided with engines and wheels of the same size and description; the only difference (of any importance) between them consisting in their models.

In former numbers of this Journal, (Vide vol. xxiv, p. 251–6; vol. xxv, 127–36,) Mr. Isherwood, Chief Eng. U. S Navy, has furnished very correct and reliable data, respecting the peculiarities and performance of each vessel; the latter being the result of several hundred hours steaming at sea, carefully tabulated from the engineer's logs. It appears from these statements that the models of the two ships present, respectively, great approximation to the forms above alluded to, as advocated by the opposing parties in ship building. The *Susquehannna* being fullest forward, but with generally sharper lines below water, (requiring increased draft to obtain the same displacement,) in the most approved "old school" style. The *Powhatan*, on the contrary, having her bow and stern lines alike, and therefore not going quite so far in the innovations advocated by the "new school." Although the difference between the two is, therefore, not that of extremes, it is quite enough to produce a marked effect upon results.

A mean of 947 hours' steaming, without assistance from sails, and in average weather at sea, for the *Susquehanna;* and of 221 hours' steaming under the same circumstances for the *Powhatan*, present the following results:

	Susquehanna.	*Powhatan.*
Speed in knots, ...	7·433	9·679
Revolutions per minute, ...	10·259	12·627
Slip in per cents, ...	19·73	16·45
Pressure in boilers, ...	8·6	10·4
Average cut-off, ...	5 ft.	4 ft. 8 in.
Proportion of throttle open, .	·375	·292
Back pressure in condenser, . . .	2·	2·
Draft of water, ...	18 ft. 3¼	18 ft. 1 in.
Dip of paddles, ...	5 ft. 3¼	5 ft. 0 in.
Displacement at that draft, . . .	3487·9	3489·6

By a fortunate coincidence (for a comparison) it will be seen that the displacement is precisely the same in both cases; therefore, *practically* speaking, the resistance to be propelled was the same, although we shall ee that the *actual* resistance and therefore power required, differed maerially.

The effective diameter of paddle wheel differs slightly, owing to the boards not being of the same width.

For the *Susquehanna* the effective diameter is 29·10 feet.
" *Powhatan* " " " 29·56 "

The loss from oblique action of paddles was in the former $19\frac{3}{10}$ per cent.; in the latter $18\frac{8}{10}$ per cent.

Now calling A = collective cylinder area, (sq. in.)
L = length of stroke, (in feet.)
P = mean effective pressure on piston during whole stroke.
$\sin.{}^2\delta$ = difference between unity and the per centage lost by oblique action.
D = effective diameter of wheel, (in feet.)
R = revolutions per minute.
S = per centage of slip.
C = coefficient of vessel's resistance.

The pressure exerted by the engine is $2\ A\ P$; and in a horizontal direction, $2\ A\ P \sin.{}^2\delta$.

The pressure of the resistance is $C \times V^2 = C \times \left(\frac{R\,(1-s)\,3{\cdot}1415\,D}{60}\right)^2$

The ratio between the velocity of the resistance and that of the power is, $3{\cdot}1415\,D$, to $2\,L$.

$$\text{Then } 2\ A\ L\ P \sin.{}^2\delta = C\,({\cdot}0086\ D^3\ R^2(1-s)^2)$$

$$\text{or } C = \frac{A\ L\ P \sin.{}^2\delta}{{\cdot}0043\ D^3\ R^2\ (1-s)^2};$$

The mean effective pressure, deducting 2 pounds less cylinder than boiler pressure, 2 pounds back pressure, 1·5 pounds for working engine, and 5 per cent. in the remainder for friction of load, would be in the *Susquehanna*, $\frac{95}{100}((6{\cdot}6+14{\cdot}7)\ {\cdot}85-(2+1{\cdot}5)) = P = 13{\cdot}87$, and for the *Powhatan* in like manner, $P = 14{\cdot}57$, whence we have for the coefficient of resistance as follows:

$$\textit{Susquehanna}\ C = \frac{7696 \times 10 \times 13{\cdot}87 \times (1-{\cdot}193)}{{\cdot}0043 \times 24642 \times 105{\cdot}24 \times {\cdot}645} = 119{\cdot}75;$$

$$\textit{Powhatan}\quad C = \frac{7696 \times 10 \times 14{\cdot}57 \times (1-{\cdot}188)}{{\cdot}0043 \times 25829 \times 159{\cdot}24 \times {\cdot}697} = 73{\cdot}88.$$

It therefore appears that the power required to drive these two vessels respectively at the same speed, with the same displacement, and under the same circumstances precisely, is really as $119\frac{3}{4}$ to $73\frac{7}{8}$, or as 1·621 to 1·000; or that with the same consumption of fuel, supposing steam to be cut off at the same point in both, their respective speeds must be as $\sqrt[3]{1{\cdot}621}$ to $\sqrt[3]{1{\cdot}000}$ or 1·175 to 1·000. By analyzing the causes of the great superiority in the *Powhatan's* model, it will be found traceable to two circumstances only; one is the reduced midship section at the same displacement, being but 644·25 instead of 673·65 square feet, owing to her having fuller lines below water than the *Susquehanna;* and the other, the position of the centre of displacement, which is 4 feet farther aft than in the *Susquehanna*, giving a cleaner and more easy entrance.

From the same log it will be observed that the consumption of fuel was in the *Susquehanna* 3279, and in the *Powhatan* 3951 lbs. per hour. Had steam been cut off in the engines of the latter at 5 feet, instead of 4 feet 8 inches, her consumption would have been increased to 4228 pounds per hour, doing the same work, while the speeds were respectively, 7·433 and 9·679; the resistances, therefore, with the same model, should have been as $(7{\cdot}433)^3$ to $(9{\cdot}679)^3$, or as 410 : 907, or as 1 : 2·212, while the relative consumptions were 3279 to 4228 :: 1·00 : 1·290, hence, $(1{\cdot}00 \div 1{\cdot}00) : (2{\cdot}212 \div 1{\cdot}290)$ :: 1 : 1·714 for the ratio of resistances in the two vessels, instead of 1 : 1·621, as before obtained; showing that from some cause, the evaporative effect per pound of fuel was better in the *Powhatan*, in the ratio of 1·621 : 1·714 :: 1·00 : 1·057.

M.

For the Journal of the Franklin Institute.

Steamers Andes and Alps.

Hulls built by Wm. Denny & Sons; Engines by Tulloch & Denny, Dumbarton, Scotland, for the British and North American Royal Mail Line, (Cunard,) to run between New York and Liverpool.

Length on deck,	236 feet 6 inches.
Breadth of beam—*at midship section above the main wales,*	34 “ 1 “
Depth of hold,	24 “
Draft of water at load line,	16 “ 9 “
Capacity of coal bunkers,	400 tons.
Length of engine and boiler space,	76 “
Tonnage,	1807 “
Weight of engine,	336000 lbs.
Weight of boilers, with water,	336000 “
Total weight,	300 tons
Frames, shape and dimensions, double angle iron,	⅂ 5¼ × ⅜ × 3
Frames, distance apart at centre,	15 inches.
Keel, dimensions,	9 × 3
Plates, thickness,	⅞ to ½ inch.
Keelsons, number and dimensions,	2, same as frames.
Masts and rig,	Barque.
ENGINES.—Two vertical beam.	
Diameter of cylinders,	5 feet 6 inches.
Length of stroke,	4 “ 6 “
Maximum revolutions per minute,	25
Geared 1 to 2½ of propeller.	
PROPELLER.—True screw.	
Diameter,	14 “
Pitch,	18 “
Number of blades,	2
BOILERS.—Two tubular,	
Length,	15 feet 6 inches.
Breadth,	9 “ 6 “
Height, *exclusive of steam chimney,*	14 “
Number of furnaces,	12
Length of grate bars,	6 “ 9 “
Number of flues or tubes,	832
Internal diameter, of “	3¼ “
Length of “	6 “ 6 “
Diameter of smoke pipe,	5 “ 11 “
Height of “ “	40 “
Maximum Pressure of steam,	10 lbs.
Consumption of coal per hour,	2000 lbs.
Description of coal,	Bituminous.

Remarks.—Rivets ¾-inch in diameter, and 3½ inches apart; plates double riveted and abutted at ends; strakes clincher laid. C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamers Building or just Finished in the United States.

New York.—Steamer (not yet named) for U. S. Mail Steamship Co., to ply between New York and Aspinwall. Hull by Wm. H. Webb. Machinery by Morgan Works.

HULL.—	
Length on deck,	275 feet.
Breadth of beam,	40 "
Depth of lower hold,	24 "
Depth below spar deck,	31 " 6 ins.
Draft loaded (expected,)	13 "
Tonnage,	2114
ENGINE.—One inclined direct action.	
Diameter of cylinder,	65 inches.
Length of stroke,	10 feet.
Average revolutions, (expected,)	16
BOILERS.—Two "drop flue," with one row of upper return flues.	
Length,	24 feet.
Breadth,	16 "
Height, except steam drum,	14 " 2 ins.
Number of furnaces,	8
Breadth "	3 " 7 ins.
Length "	8 " 3 "
Grate surface,	228·25 sq. feet.
Total heating surface,	
Steam pressure,	15 pounds.
WHEELS.—	
Diameter over boards,	34 feet.
Length of "	8 "
Depth of "	1 " 4 ins.
Number of "	28

Remarks.—Frames of ship, 18 inches deep, and sided 16 inches; distance apart, (centre to centre,) 32 inches; double diagonal iron straps, $5\times\frac{3}{4}$ inches; floor filled in solid.

On a new Plastic Material for forming various Objects. By Prof. PURKINJE.[*]

Five parts of sifted whiting are mixed with a solution of 1 part of glue. When the whiting is worked up into a paste with the glue, a proportionate quantity of Venetian turpentine is added to it, by which the brittleness of the paste is destroyed. In order to prevent its clinging to the hands whilst the Venetian turpentine is being worked into the paste, a small quantity of linseed oil is added from time to time. The mass may also be colored by kneading in any color that may be desired. It may be pressed into shapes, and used for the production of *bas-reliefs* and other figures, such as animals, &c. It may also be worked by hand into models, during which operation the hands must be rubbed with linseed oil; the mass must also be kept warm during the process. When it cools and dries, which takes place in a few hours, it becomes as hard as stone, and may then be employed for the multiplication of these forms.—*Gewerbebl. aus Wurtemb.*, 1852, p. 45.

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[*] From the London Chemical Gazette, No. 233.

For the Journal of the Franklin Institute.

Statistics of the Philadelphia Gas Works.

From the "Eighteenth Annual Report of the Trustees of the Philadelphia Gas Works," including also the Report of the Engineer, John C. Cresson, Esq., we quote the following facts:

The total amount of gas made at the works for the year ending December 31st, 1852, was 216,216,000 cubic feet.

Of which there were delivered to private consumers,		169,268,000	cubic feet.
Public lights,		38,306,250	"
Used in works, offices, coal stores, and leakage,		8,641,750	"
		216,216,000	"
To produce this gas, there were used—			
Coal in the retorts,		680,792	bushels.
Coke used under the retorts,	450,832		
Coke used in the yard and works,	13,500		
		464,332	"
Lime for purifying,		49,149	"
And the surplus of coke made in the retorts after deducting that used to produce the gas, was		404,680	"

It will therefore be seen that one bushel of coal made,

Of Gas,	316·13 cub. ft.
Of Coke,	1·26 bushels,

and that one bushel of lime purified 4400 cubic feet of gas.

The total length of street mains now laid (in the city proper,) is, 604,166 feet, or 114·44 miles, of sizes varying from 2 to 20 inches in diameter.

The number of private lights supplied, was—		
In the City proper,	157,170	
In the Districts,	9,085	
		166,255
Of public lamps supplied in the City,	1,818	
" " " Districts,	308	
		2,126

The Philadelphia Gas Works is the largest, and was one of the first establishments of the kind in the United States; and the price of gas is lower than from any other works in the Union, being but $1·90 per thousand to customers making prompt payment. Its growth has been so rapid as to render necessary a removal of the manufacturing department, owing to want of space in its present position. The gasometers, however, will remain at the old place; they are eleven in number, and of the following sizes; eight single, 50 feet diameter, 20 feet high; two telescopic, 80 feet by 40 feet; and one telescopic, 140 feet diameter, and 70 feet high, which last is still the largest in the world. At the new works the trustees are erecting a grand distributor, 160 feet diameter by 96 feet, telescopic, which will hold nearly two millions cubic feet. The average daily consumption during the past year has been about 600,000; the maximum consumption for 24 hours was 1,123,000 cubic feet.

Drawings and descriptions of the two large gas-holders and framings are now in course of preparation, and will be published in this Journal when completed.

For the Journal of the Franklin Institute.

What became of John Fitch?

As it is to this day an unsettled point, what city of the East had the glory of being the birth-place of Homer, so it has been equally undetermined as to the place in the great West where the mortal remains of one greater than Homer, have their resting place; I mean the great embodied *Genius of Steam;* the indigent, friendless machinist, John Fitch; the co-worker and adviser of Rumsay and Fulton. My object, however, is not to write an eulogy, much less a biography of the immortal Fitch, but simply to indicate the precise place of his interment. The writer of this having occasion, some twenty-five years ago, to bury a little nephew at Bardstown, in Nelson county, Kentucky, and having discovered in the crowded little protestant grave yard near the county jail, an open space 20 or 30 feet square, not occupied by graves, commenced digging his nephew's grave there, when he was stopped by the aged Sexton, Mr. Alex. McKeown, who said that spot "contained the bones of John Fitch, the great steam man;" that "the space was left thus large to build a monument to his memory by the State of Kentucky."

Hon. Ben Hardin and Dr. Burr Harrison, of whom inquiry was made, corroborated the statement of Mr. McKeown, the sexton, and stated that a resolution to erect a monument over Fitch had passed the Legislature of Kentucky, of which they had been members, but that no appropriation had ever been made to carry the resolution into effect. The aged sexton must long since have passed from earth, and it is probable there are now few, even in Bardstown, who could point out the grave of John Fitch.

Alexander M. McDowell.

Demopolis, Ala., July 6th, 1852.

On the Decomposition of Ammonia by Heat, and the employment of the Gaseous Mixture thus produced in Analysis. *By* M. Bouet Bonfil.*

The author has found that ammoniacal gas, when passed through tubes filled with quicklime, is resolved into its elements, nitrogen and hydrogen, at a heat far below redness. In empty porcelain tubes, or in tubes filled with fragments of porcelain, the decomposition is imperfect. The author proposes to employ the mixed gases obtained by this mode of decomposition to the reduction of metallic oxides, where the nitrogen can do no harm. It is easy in this way to obtain hydrogen gas perfectly free from arsenic, antimony, carbon, &c.—*Comptes Rendus*, xxxiv. p. 588.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 17, 1853.

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from The Royal Institution, and

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* From the London Chemical Gazette, No. 233.

The Royal Astronomical Society, London; L. Lea, Esq., U. S. Commissioner of Indian Affairs, City of Washington, D. C.; T. H. Forsyth, Esq., G. H. Hart, Esq., and J. C. Bryant, Esq., Pennsylvania Legislature; Dr. H. Hartshorne, P. A. Nicholson, T. Wadskier, the Philadelphia Gas Works, and the Mine Hill and Schuylkill Haven Railroad Company, Philadelphia.

Donations to the Cabinets from Dr. Isaac Smith, Dutchess county, N. York; A. P. Wattson, Esq., and Thomas Fisher, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of January.

The Board of Managers and Standing Committees reported their minutes.

The Special Committees reported progress.

New candidates for membership in the Institute (6) were proposed, and the candidates (6) proposed at the last meeting were duly elected.

The Standing Committees for the ensuing year were nominated by the President, and appointed as follows:

On the Library.

John Allen,
James H. Cresson,
Samuel Capp,
George Erety,
Raper Hoskins,
J. Herman Hoeckly,
Amos Lukens,
William A. Rolin,
Clement W. Smith,
Thomas S. Stewart.

On Cabinet of Models.

Samuel S. Ash,
Harman Baugh,
William W. Babbett,
Washington Jones,
Israel W. Morris, Jr.,
Henry Newsham,
F. De B. Richards,
Charles J. Shain,
John A. Wimer,
Charles Welsh.

On Exhibitions.

John E. Addicks,
John Agnew,
H. P. M. Birkinbine,
John C. Cresson,
George W. Conarroe,
Owen Evans,
William Forsyth,
Algernon S. Roberts,
Alan Wood,
Thomas J. Weygandt.

Cabinet of Minerals and Geological Specimens.

John F. Frazer,
Wm. W. Fleming,
Angus N. Macpherson,
John S. Powell,
Dr. B. Howard Rand,
Percival Roberts,
Thomas F. Seal,
Dr. L. Turnbull,
Dr. C. M. Wetherill.

On Meetings.

Dr. Charles M. Cresson,
Stephen Colwell,
George W. Dewey,
Daniel Leeds,
J. Vaughan Merrick,
Dr. B. Howard Rand,
George W. Smith,
Charles E. Smith,
Dr. L. Turnbull,
Dr. C. M. Wetherill,

Cabinet of Arts and Manufactures.

James C. Booth,
Joseph J. Barras,
Samuel M. Bines.
George M. Conarroe,
William Harris,
William B. Smith,
J. McA. Sommerville,
Thomas J. Weygandt,
Isaac S. Williams,
Lewis E. Wells.

On Meteorology.

Dr. Martin H. Boyé,
Dr. Charles M. Cresson,
Owen Evans,
John F. Frazer,
L. C. Francis,
James A. Kirkpatrick,
Dr. James A. Meigs,
Dr. George R. Morehouse,
Dr. James V. Patterson,
Dr. George J. Ziegler.

Dr. Rand called the attention of the members to a Colt's revolver, (No. 1140,) which had nine balls jammed immovably in its barrel, and illustrated in a remarkable degree, the strength of the cast steel revolving chamber. It was sent to him by Dr. Casper P. Lukens, of Illinois, from whom he had the following account of the circumstances:

The revolver had been in his possession more than three years, and has been fired over one thousand times without getting in the least out of order; in accuracy it was nearly equal to a duelling pistol. On the day previous to the accident, he had fired it seventy-five times. On the succeeding day he set his target upon a board, nearly the size of a window shutter, distance seven paces. The first ball put into the chamber was one that had been previously used, and was covered by a patch; the other balls used were too large for the chambers, and had to be forced down with an iron rod and hammer, leaving a ruff of lead around the bore; aim was taken, the pistol fired, no balls struck the board, the pistol making a louder report each time. It was again loaded, and four out of the five chambers discharged without any effect upon the board; the cock was driven back, the pistol almost driven out of the hand, and at the fourth discharge the bolt of the hammer was broken. On examining the barrel, it was found filled to within about two and a half inches of the muzzle with lead, and the last ball was found flattened against the lead at the breech of the barrel, a hemisphere of the ball fitting into the chamber. As the pistol could still be cocked, he fired another load of powder, but as may be supposed, without moving the mass of lead.

The powder used was of good quality, having on the previous day carried a ball 250 yards over still water with an elevation of 6 inches, and perforated an inch pine board at thirty paces; about twelve grains were used as a charge. The caps were Colt's regular army. It was found impossible to drive out the lead by a rod and hammer.

As exhibited, the pistol presented its barrel about two-thirds full of lead, having a flattened ball, with its rounded portion fitting into the chamber. Except the broken pin mentioned, it was not damaged. Dr. Rand remarked that the windage between the chamber and the barrel was considerable, admitting readily a sheet of ordinary paper. Much of the expansive force of the powder might have found vent there, in the eight first discharges; but at the ninth the chamber was effectually closed by the hemisphere of the ball projecting into it, and jammed against the mass of lead, filling the barrel, so that the only vent for the explosive force was at the nipple, which was of ordinary size.

Dr. Rand also presented an exceedingly neat and portable hygrometer made by Mr. Thomas J. Weygandt. It is composed of a wooden helix; the inner portion of which is pine, cut across the grain; the outer, mahogany, cut in the direction of the grain. One extremity is fixed, the other connected with an index traversing a graduated dial. The unequal expansion of the outer and inner portions of the helix by moisture, causes a change in its form, which is indicated on the dial. The instrument, which is quite sensitive, is enclosed in a neat case of less than six inches cube.

Mr. Joseph Harrison exhibited to the meeting two iron cases, which had been made the subject of experiment, in determining the strength of stayed plates. The largest plate, 28 inches square, rim $\frac{3}{8}$-th inch thick, stays, $6\frac{1}{2}$ inches apart; $\frac{7}{8}$-inch diameter outside of the thread. It was proved at 900 pounds hydraulic pressure to the square inch, at which pressure no effect was produced. The smaller, 18 inches square; rim,

$\frac{1}{8}$-th inch thick, stays $\frac{1}{2}$-inch diameter outside of the thread, and $2\frac{3}{4}$-inches apart; proved at 295 lbs. pressure. This exhibited very marked appearance of bulging between the stays. The experiments were made at the works of Messrs. Harrison, Winans & Eastwick, at St. Petersburg, in 1848.

Mr. Harrison also exhibited a piece of leaden gas pipe eaten by rats. This piece of lead pipe formed part of a connexion for conveying gas from the basement to the first floor of a house he occupied in Liverpool, England, in 1850. The pipe passed through the ceiling of the basement story, and through the floor of the room above. Three several times the pipe was eaten through in the parts that passed between the ceiling and the floor. It was prevented from occurring again by putting in a piece of copper pipe, long enough to reach through the ceiling and floor.

The President remarked that when he was making the researches upon gas lighting in London, he found this occurrence so frequent as to cause him to recommend that the use of lead gas pipes be prohibited in this city, and iron substituted.

Mr. Harrison also submitted for the inspection of the members an exact model, reduced, of the great bell of Moscow. The original bell is 21 feet in diameter, and 21 feet high. The metal at the thickest part, 22 inches. It is estimated variously, to weigh from 400,000 to 444,000 pounds. It was cast in 1733. Also, specimens of the platina coins formerly in circulation in the empire of Russia. The specimens exhibited were of the respective values of \$9·00, \$4·50, and \$2·25.

Mr. Enoch Woolmann, of Stark county, Ohio, exhibited a model of a plan for opening and shutting farm gates when riding or driving.

This gate is constructed by applying bevel cog work to the heel stile of the gate. The vertical cog piece has a lever, to which is attached a cord; this cord passes over pullies, and is suspended over the centre of the passage at a convenient distance from the gate, so that the driver can without raising from the seat, grasp it and pull the gate open, by pulling on the cord until the gate is entirely opened; it is fastened open, and all that is necessary in order to close it, is to give the cord on the opposite side a slight jerk, and the gate immediately closes and fastens by means of a weight.

Dr. Turnbull brought before the meeting a sample of compressed or solidified milk, manufactured at Dutchess County, New York, by Blatchford & Co., and sent to the Institute by Dr. Isaac Smith. It was in the form of square cakes of a compact crystalline character, yellowish white color, and sweet taste, resembling sweetened boiled milk. The following are the properties which it possesses, as stated in the letter from Dr. Smith. "It keeps well in any climate, and can be readily restored to the consistency of milk by adding one pound of it grated to two quarts of warm water. So little is it injured by the solidification that a good cream will rise on the solution after standing a few hours, and it readily coagulates when rennet is added to it."

The experiments made with it by Dr. Turnbull were not as satisfactory as those stated in the letter; for when warm water was added to the powdered material, there was not formed a perfect emulsion; numerous oily globules remained upon its surface.

With a solution of rennet in wine, it coagulated; on standing over night it formed a covering of white pellicles of an albuminous substance, like the covering on milk after having been boiled; but it had not the true taste of cream, the liquid under it being sweet forming no lactic acid.

Dr. Turnbull had no doubt, however, that on a long voyage it would prove a good substitute for milk, although not as perfect as it might be made or as it is now made in France. He stated that the French method of preserving milk for long voyages was the following: pure fresh milk is mixed with well clarified raw sugar, in the proportion of four ounces to the gallon, and evaporated in open pans, fixed on steam boxes and connected with hollow steam pipes, kept at a temperature varying from 176° to 194° Fahr. During the whole of the time, agitators are caused to move round slowly in the milk by turning a handle; as the milk approaches the solid state, it is taken out of the pans and pressed in moulds into cakes of any suitable shape.

Mr. Frazer exhibited a rule, upon which were laid down equivalent portions of the various European measures. By means of a straight-edge moving over the scale, the expression of any one measure in divisions of another was readily obtained.

Mr. F. O. Deschamps exhibited and explained his passenger register for omnibuses. This instrument is placed in the front panel of the omnibus, and resembles in appearance, a clock face numbered up to 36, with a single index.

It is the duty of the driver, upon the receipt of each fare, to pull a handle, which rings a bell inside the instrument, and at the same time causes the index to move forward one division upon the dial, while a similar record is made upon a second dial placed upon the same arbor as the index hand. This second dial is concealed behind the face of the instrument. When the second dial has revolved once, by means of a toothed wheel, notched cylinder and click, a third dial is moved forward one division, corresponding to thirty-six records upon the first. By continuing this arrangement, the instrument is made to record upon the internal and concealed dials up to 10,000 fares.

The external hand may be moved forward or back, or held stationary, during the ringing of the bell, without interfering with the regular registration on the internal dials.

The concealed dials have their index number brought into view through an opening in the face, by opening the glass covering it, and inserting a key in an appropriate hole, and turning back the portions of the face, covering the index number. The dial is examined by the agent at the terminus of the route at the end of each half trip, and the number registered thereon noted. The index is then returned to 0. The internal dials are examined by a second agent at the end of the day, and the driver is accountable for the fares marked thereon. The dials cannot be reversed save by a key in the possession of the proprietors alone. When the index numbers of the internal dials are exposed, the bell-pull is locked, so that no further record can be made until they are again hidden.

The agent who inspects the external dial at the end of each trip, and returns its index hand to 0, can only open the glass covering the face, and cannot expose the index numbers of the second, third, and fourth dials. The agent who takes the account at the end of the day, inspects the internal dials, but cannot alter them; hence he acts as a check upon the driver and the first agent, while it is in the power of the proprietors at any time, by a simple inspection of the internal dials, to satisfy themselves of the correctness of the records.

Should the driver neglect to ring the bell, his dishonesty is apparent to all within the coach, among whom may be a secret agent of the proprietors, and the knowledge of this fact will tend to prevent any such attempts on his part.

The novelty claimed in this instrument is, the use of a ratchet and pawl to prevent the bell being rung by the recoil of the hammer, and the arrangement of the internal concealed dials for recording up to tens of thousands of fares.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on E. G. Pomeroy's Process for Coating Iron with Copper.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Process for Coating Iron with Copper," invented by Mr. E. G. Pomeroy, of Baltimore, Maryland—Report:

That the main features of this process, the preparatory cleansing of the iron from adhering oxide, and subsequent dipping in a bath of the melted covering metal, resemble those already in common use for tinning and zincing iron. The novelty consists in the mode by which the surface of the iron is preserved in a perfectly clean metallic state at the high heat to which it has to be subjected, before it can be dipped in the melted copper. This is effected in the following manner. After the iron has been cleansed by rubbing and pickling, it is dipped for a moment in diluted sulphuric acid, then withdrawn, and the adhering acid quickly dried up on the surface of the plate by holding it over a hot fire. The iron thus covered with a thin adherent coat of sulphate is then again dipped in a thick slip of rather fusible clay, which is dried up as before by exposure to the fire. The plates thus coated are placed in a suitable furnace, and raised to a heat considerably above the melting point of copper; in this state they are dipped, one at a time, in a bath of copper kept in a state of fusion in a reverberatory furnace. The clay coating of the plate, rendered still more fusible by the silicate and sulphuret of iron formed at the heat employed, separates as a fluid slag on the surface of the bath, as the iron plunges beneath it, and the iron is withdrawn covered with a uniform coating of melted copper.

The copper plates shown the Committee had all been subsequently passed through the rolling mill to give them a smooth and polished surface. When annealed, these plates seemed to possess all the qualities which could have been expected. The toughness of both iron and copper was unimpaired; at the same time their adhesion to each other was such that no amount of working and bending at sharp angle as in a lap joint seemed to occasion any separation.

A plate with its exposed iron edges previously protected by wax, was immersed in diluted sulphuric acid (5 water to 1 acid) for a week, without any disengagement of hydrogen, showing the copper coating to be continuous.

The Committee regret that some iron spikes coated at their request by this process, which from their irregular shapes could not be rolled after they had been dipped, did not seem to be so completely protected, as the iron was rapidly dissolved, the gas escaping through numerous minute pores in the copper surface; whether this porosity was only accidental in this case from the rougher surface of the spikes preventing a perfect cleaning, or whether it is the natural state of the coating in its unrolled condition, the specimens supplied the Committee have been insufficient to determine. If subsequent rolling is essential to close the pores of the copper surface, it will shut out many useful applications of the process to articles of irregular form.

The Committee consider that Mr. Pomeroy has attained a gratifying success in a very difficult object; the materials employed in his process are cheap and abundant, and the manipulation simple. The Committee think that the coppered sheet iron will be a new and valuable addition to the materials used in the arts, and would specially call attention to its applicability to roofing, rain pipes, and other uses in which iron is exposed to atmospheric agents. At the cut edges of the sheets, oxidation of the iron would at first sight seem likely to occur with increased rapidity from galvanic action, but as the oxide of iron thus formed is retained in place by the films of copper on either side, the Committee consider that in practice this corrosion will be found unimportant in extent.

By order of the Committee,

Wm. Hamilton, *Actuary.*

Philadelphia, Feb. 10th, 1853.

Report on Junius Judson's Governor Valve.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Governor Valve," invented by Mr. Junius Judson, of Utica, New York—Report:

That this invention is intended to improve the system of governing or regulating the admission of steam at the throttle valve of a steam engine, and consists, 1st, of a modification in the form of valve used; and, 2nd, of a means of balancing the pressure of steam upon it, rendered necessary by the small amount of power developed by the governor; this alteration being rendered necessary by the adoption of the preceding. The usual form of valve used for governing, is pivotted at or near the middle of its area, and has beveled edges, so as to make a joint tolerably tight when closed. But that valve, from its construction, possesses the defect of opening unequal areas with equal radial movement at different positions, so that after an increase of speed of the engine has raised the balls to full height and closed the valve, they are required to fall considerably before the valve opens an area large enough to admit the usual quantity of steam to the cylinder. By this time the engine will have slackened its speed, when the impetus given it by the fresh inlet of steam again throws up the balls, so that a kind of oscillation in the valve is kept up, which is not favorable to uniform velocity of the engine.

The invention in question is an attempt to overcome this difficulty in the following manner: The valve itself is a disc with two opposite quadrants (or nearly such) removed; it is, therefore, of the description usually known as "fan valve." Its face is ground flat with the face of a valve seat, on which it revolves, and through which two openings are made of a shape such that successive areas of these openings are uncovered by the valve in its motion, proportioned to the requirements of the engine. In other words, the valve is opened more rapidly at first, and with a movement more uniform than the butterfly valve.

In combination with this valve there is a regulating screw pressing against the face, which by being screwed in or withdrawn, relieves the valve from the friction incident to the steam pressure on its back, and so renders it easy to move it by the power of the governor balls, while at the same time the leakage is not materially increased.

It is furthermore the design of the inventor to alter the arrangement of the governor itself, as usually made, so that the arms when at rest occupy a position nearer to horizontal; this is done in order to make the angular motion more nearly proportional to the vertical heights to which the balls are raised by the motion of the engine, (or which is the same,) to equalize the motion of the valve on its seat.

The defect previously pointed out is one which is known by engineers to be incident to the old arrangement for governing; and to produce so much irregularity of motion that it cannot be employed without modification for some branches of manufacture which require a very uniform speed, as for instance in the cotton manufacture. It is the opinion of the Committee, both from an examination into the principle on which Mr. Judson's improvement is based, and from observation of its application to some engines in this vicinity to which they have had access, that it promises decided advantages over the ordinary arrangement, and deserves to be generally introduced.

By order of the Committee,

Wm. Hamilton, *Actuary.*

Philadelphia, Feb. 10th, 1853.

BIBLIOGRAPHICAL NOTICE.

A Treatise on Hydraulics for the use of Engineers. By J. F. D'Aubuisson de Voisins. *Translated from the French, and adapted to the English Units of Measure. By* Joseph Bennet, *Civil Engineer.* Boston: Little, Brown & Co., 1852. 8vo. pp. 532, and 5 plates.

There is no subject within the range of applied science which presents more practical interest to our country than that of hydraulics. Our immense and extensively distributed water power, the sparseness of our settlements, and the high rate of interest consequent upon the great demand for capital, render hydraulic power the great resource of far the largest part of our country. Hence, the very great number of patents for water wheels and other hydraulic machinery, which grace the records of our patent office. But the greater brilliancy and attractiveness of steam power, the demand for it in the vicinity of our large cities and other places, where the population is more dense, and circumstances tend to make it the cheaper motor, have drawn the attention of our scientific men, and even of the more scientific of our experimenters, away from the force of water; and hence, with much ingenuity, and very much of patient individual labor, our country has presented but few important contributions to practical hydraulics—the most marked exceptions, so far as we know, being the Report of the Franklin Institute Committee on Water Power, a work yet incomplete, and the as yet unpublished experiments of Mr. Zebulon Parker, the inventor of what may with justice be termed the American Turbine.

The situation of France in reference to motive power, is to a great extent similar to our own. But there the large body of able engineers which her schools of practical science have so long and so continually given her, has led to the fullest and most scientific investigation of the subject, and hence it is to France principally that we are to look for the most ample and most reliable data for the establishment of hydraulic works.

Among the most valuable contributions to the advancement of our knowledge in this department, is undoubtedly the long celebrated work of D'Aubuisson; a work not of mere theory, or of mathematical investigation, but a mass of extensive and well directed experiments, made by men fully familiar with all that had been done and supposed before them, and performed with all the care for which French experimenters are so celebrated. These experiments are carefully tabulated, well discussed, and the formulæ resulting from them are expressed as simply as possible, and in the most useful form for hydraulic engineers. This work has been ever since its first appearance a text book for French engineers and constructors, and many of its most useful tables and most important results have been made accessible to the American student, by transfer to works in our own language.

We have now, however, in the book before us, a translation of the work itself, and we can hardly conceive of a more valuable addition to our books upon practical science than this translation. In order to facilitate the application of the formulæ, the translator has converted the French measures into English, and thus saved his reader much trouble.

We may regret that while his mind was upon the subject, the editor did not examine the more recent contributions which have been made in France and Germany to our knowledge of hydraulics, and thus bring his subject perhaps more fully down to the present day; but we are not sure that any important changes in the resulting formulæ would have been made by so doing, and in our thankfulness for the work as it is, we are not disposed to cavil at it for what it ought to have been. The work is handsomely got up, and well printed, and we hope it will find its way into the hands of all our hydraulic inventors as well as engineers, who will find the expense of it repaid an hundred fold, by the amount of labor and time its perusal will save to them. F.

Errata.

Page 204, line 16, for "2 A P," read "A P."
" " " 17, for "2 A P sin. $^2\delta$," read "A P sin. $^2\delta$."

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

APRIL, 1853.

CIVIL ENGINEERING.

Extract from the Report of the Board of Trade on Railways, for the year 1851.—Accidents, their Causes and Means of Prevention.[*]

On the subject of accidents it is to be observed that 36 passengers have been returned as killed, and 375 injured, during the year 1851; these numbers showing a very great increase as compared with the preceding year, when only 32 passengers were killed and 183 injured.

It must not be assumed, however, that all of these accidents to passengers were accidents arising from causes beyond their own control, and are therefore to be considered as attributable to the dangers of railway traveling; for, upon examining the returns, it appears that during the year 1851 no less than 17 passengers were killed and 20 injured owing to their own misconduct or want of caution, leaving 19 killed and 355 injured as the total number of sufferers from causes beyond their own control.

With respect to the 37 passengers either killed or injured by their own misconduct or want of caution, it appears that no fewer than 24 of these accidents (9 killed, 15 injured,) arose from passengers attempting either to get into or out of trains whilst in motion.

On this subject it may be worthy of observation that during the same period (the year 1851) eight servants of Railway Companies, persons therefore, it may be presumed, in the habit of moving about, more or less, upon engines and trains, were killed, and seven injured from the same cause

[*] From Herapath's Journal, No. 706.

Such a statement ought to operate as a caution to passengers not to leave their seats or to attempt to get into carriages while the trains are in motion; for if experienced officials constantly employed upon railways meet with such frequent disasters from this cause, it is naturally to be expected that inexperienced people, in making similar attempts to get either upon or off trains in motion, will be much more subject to accidents of this character.

Proper caution on the part of the public in this respect would produce a very material diminution in the list of casualties; and it may deserve consideration whether it might not conduce to this caution if notices were posted conspicuously in stations and carriages, warning passengers of the danger to be apprehended from this improper practice.

After deducting the numbers of those killed or injured by their own misconduct or want of caution, it would appear that during the year 19 persons were killed, and 355 injured, from causes beyond their own control.

This result, giving a total of 374 sufferers, when viewed with reference to the number of passengers conveyed during the year, which amounted to 85,391,095, appears not unsatisfactory, being about four in 1,000,000; but when compared with the returns of the preceding year (1850), it appears that the traffic has not been conducted nearly with the same degree of safety in 1851 as in 1850; for while the number of passengers conveyed has increased in the ratio of about 17 per cent., the number of passengers injured by causes beyond their own control, which may be considered as a measure of the relative safety upon railways during different periods, has more than doubled, the ratio of increase being 104 per cent.

It will be found also, upon reference to the last Annual Report of the Commissioners of Railways, that the casualties in 1850 more than doubled those that occurred in 1849, so that relatively the risk of danger in traveling upon railways appears to have considerably increased.

It is matter of observation that this increase of accidents has taken place concurrently with the extension of the system of excursion-trains, which has been principally developed within the last two years; and it is also to be observed that in the same period the number of persons employed upon each mile of railway open for traffic has decreased, as shown by the returns presented to Parliament, which are made up for the 30th of June in each year, at which date it may be presumed that the excursion traffic is in full operation.

The average number of persons employed upon all the railways in the United Kingdom open for traffic were, on the

30th June, 1849, ...	10·27 per mile.
29th June, 1850, ...	9·56 "
30th June, 1851, ...	9·49 "

It is, however, right to observe that this reduction in the average number of persons employed may be in some degree attributed to improvements in the management of the railways, and to the consideration that the railways which have been opened in late years have traversed less populous districts than the railways first constructed, and have therefore required fewer persons to conduct the traffic upon them.

It has been thought desirable, with a view to ascertaining the causes of these accidents, and to the consideration of the question whether any remedial measures might not be adopted, either by Parliament or by the Companies themselves, to analyze the reports that have been made by the inspecting officers appointed either by the Commissioners of Railways or by your lordships to inquire into such of these accidents as seemed to call for investigation.

These reports will be found in the Appendix, and have reference to 41 accidents, comprising the whole of the 19 passengers before stated to have been killed during the year by causes beyond their own control, and 319 of the 355 before stated, as the whole number of persons injured during the year from like causes.

In addition to these casualties to passengers, nine servants of railway companies were killed and four injured by the same accidents; so that it will appear that the 41 Reports which are analyzed in the following observations embrace all the more important accidents which have occurred during the year upon the railways of the United Kingdom.

These accidents may be classified under two heads:—

1. Those which arise from accidental failure of machinery, or from defects in the roadway or works.

2. Those which arise from defects in the establishment and management of the railways.

This head may be further subdivided into—

A. Inherent defects in the system upon which the traffic is conducted.

B. Defects in regulations.

C. Inattention to regulations, or inexperience of servants.

D. Want of punctuality.

Of the 41 accidents that have been reported upon, 2 only appear to belong exclusively to the first class, while 25 belong to the second class, and in 14 are involved circumstances falling under both classes.

It is to be observed that accidents very seldom occur upon railways from any one cause, but generally are brought about by a combination of circumstances, each contributing to produce the result.

In 16 of the above 41 accidents were involved circumstances affecting the machinery or works of the railway, and which come therefore under the first head. Two of these only, so far as they could be traced, appear to have been purely accidental, and to fall exclusively under that head; in the other 14 are involved circumstances affecting the establishment and management of the railways.

In five of these latter were involved mistakes, either from carelessness or inexperience at what are commonly termed meeting or facing points at junctions or sidings, showing the importance of reducing as far as practicable the number of these useful but otherwise objectionable contrivances. As at present generally constructed, these points are self-acting; that is, when not held otherwise by hand they are always in one position, being retained in it by weights, and the trains then pass over them always in one direction; after being used to turn trains in another direction, they resume their original position by the action of the weights.

It is to be observed, that if these points act properly there ought to be but little risk in trains passing over them; but if a stone or any other hard substance should chance to get between the movable points and the fixed rail, the points remain partly open; or if the points, from a jerk of a passing train or from any other cause, shift their position, there is great reason to fear that the train may pass partly along one line and partly along the other. This actually happened to three of the cases referred to, producing most dangerous accidents. It is worthy of consideration whether some means should not be provided by which all meeting or facing points which are passed over constantly by passenger trains shall be fixed at all times, the means provided being such that the fastening could not be applied before the points are completely closed. It is believed that means for this purpose might be provided of a very simple and inexpensive nature.

In four of the cases under the first head it appeared that the locomotive stock was deficient, chiefly in consequence of the engines being overtasked; in two of them that the permanent way was out of repair; in one case a bridge had been partly taken down for alteration, without proper precautions having been taken to warn the drivers of coming engines; and in one case the station accommodation was inadequate for the requirements of the traffic which had developed itself upon the railway.

Under the divison of what has above been termed the establishment of the railways, including its management and staff of servants, it appears that in 27 cases are involved circumstances which come under the Class A., in 13 cases are involved circumstances which come under the Class B., in 23 cases are involved circumstances which come under the Class D. Out of the 27 cases involved circumstances which come under the Class D. Out of the 27 cases in Class A., in which are involved defects that are inherent to the system upon which the traffic is conducted upon railways, it appears that in two cases the luggage placed upon the roofs of the carriages had taken fire; in 24 collisions between trains had occurred, and of these 19 were cases in which trains conveying passengers had come into collision with trains conveying goods; 4 were cases in which passenger trains had come in contact with passenger trains; in one case a goods train with a goods train; and in one case a passenger train with a return engine unaccompanied by a train.

The necessity that exists for trains to traverse railways at different speeds adapted to the particular descriptions of traffic conveyed by them, whether passengers, goods, or minerals, produces a liability to accident from collision which is inherent in the system upon which the traffic of railways is at present conducted, and from which it must be difficult, if not impossible, to free it.

The facts as stated above appear, however, to point to the principal defect of the system, viz., that merchandise and minerals are conveyed over the same lines of rails that are used for the conveyance of passengers.

One remedy for this principal defect of the system, would be the addition to existing railways of lines to be used exclusively for the heavy traffic of goods and minerals. This would mitigate the evil, and much reduce the chances of accident of this nature, but would be generally inapplicable on account of the vast expenditure that would be requisite to carry it into effect, and after all it would only partly remove the chances of collision, which would remain to a certain extent so long as passenger trains traverse railways at different speeds.

Another remedy that suggests itself is, the separation of the two descriptions of traffic, goods and passengers, and conducting them at different times. This practice has been adopted to a great extent on many railways, the goods being conveyed as much as possible by night, so as to interfere with the passenger trains to the least practicable extent.

The third remedy that suggests itself is, that all trains, whether goods or passengers, and all engines which traverse railways, should be worked to well-adjusted time-tables, and that punctuality should be enforced. It will be seen, upon examining the reports, that in 23 of the accidents as to which inquiries have been instituted, it has been ascertained that the trains have been unpunctual or irregular as to time. In 21 of the collisions it appears that irregularity of the trains was one of the concurrent causes which tended to produce them. Upon consideration of the reports it appears wonderful that more of these accidents do not occur; for it is recorded that in some instances goods and mineral trains are sent along railways under the direction of engine drivers, whose only instructions are to proceed to the destination intended for their charge, dropping trucks at stations where necessary and taking up others, without any instructions at all as to time, but with the understanding that they are to get to their journey's end as best they can, so that they deliver the goods at the required places. This understanding or instruction is, however, subject in most cases to certain general regulations, such as, that no train is to follow another within a given time, and that goods trains are to be shunted or moved off the main line when a passenger train is expected within a stated time. Experience, however, shows that these regulations are not sufficient. The interval between trains, as will hereafter be explained, depends upon a number of contingencies, and after all is only to be maintained by the numerous signalmen stationed along the line of the railway, whose responsibility is therefore divided, and not by any of the persons employed upon the train. The shunting of the trains depends upon the unoccupied siding accommodation being sufficient to contain the train at the place where the operation may be necessary, and which is often found not to be the case.

It would appear, then, that the principal guarantee of safety when the traffic is conducted on this system, is the vigilance and superior intelligence of the drivers and persons to whom is entrusted the conduct of the trains.

In some districts where the goods traffic is of a very fluctuating nature, it may be difficult to arrange so that the hours of arrival and departure of all goods trains shall be advertised and known beforehand with the same exactitude as passenger trains; but it is considered, and is found on many railways, that a large portion of the traffic of this nature is as regular and capable of as much exactitude in respect of time as the ordinary passenger traffic. There can be no valid reason why goods traffic of this regular nature should not be conducted on the same principle as the regular passenger traffic, with carefully adjusted time tables, and with punctuality. As to other traffic, which is in addition to the regular or ordinary traffic, and is of a more fluctuating nature, including goods and passengers conveyed by what are commonly termed excursion trains, or special goods trains, it may be well questioned whether a general instruction to an engine driver to proceed on his journey to his destination, taken in conjunction with the regulation above alluded to, is a sufficient security to the public that the traffic will be conducted with a due regard to the safety of the travelers conveyed by railway.

To be Continued.

Railway Traffic in Great Britain in 1852.*

It appears that the gross traffic receipts of railways in the United Kingdom for the year 1852 have amounted to 15,543,610*l.*, being at the rate of 2118*l.* per mile per annum. The returns published weekly show that 15,088,310*l.* was received on the railways during the past year on 6915 miles, including about 200 miles of canal, being an increase of 520,400*l.* in the receipts over the preceding year on 6537 miles of railway, and also an increase of 378 miles in operation. Independent of these railways, there are about fifteen new lines in operation of an aggregate length of 240 miles, the returns of which are not published weekly, but may be estimated at 181,000*l.* In addition to these there are ten other lines of an aggregate length of 183 miles, belonging to old railway companies who do not publish their traffic returns; but it appears from the half yearly reports that the gross receipts on these lines are about 274,300*l.*, making together 455,300*l.* This sum, added to the published weekly receipts, shows that the gross traffic receipts on the above railways during the past year amounted to 15,543,610*l.*

With regard to the traffic returns published weekly, they show a progressive increase during the past eleven years. In the year 1842, they amounted to 4,341,781*l.*; in 1843, to 4,842,650*l.*; in 1844, to 5,610,980*l.*; in 1845 to 6,769,230*l.*; in 1846 to 7,689,870*l.*; in 1847, to 8,975,671*l.*; in 1848 to 10,039,000*l.*; in 1849, to 11,013,820*l.*; in 1850, to 12,757,985*l.*; in 1851, to 14,567,910*l.*; and in 1852, to 15,088,310*l.* From this it will appear that the annual increase in the past ten years, being on the average more than one million a year, or during the ten years, is 10,746,529*l.* This increase partly arises from the continual development of the traffic on the trunk lines, and partly from the additional receipts derived from the opening of new lines and branches. The increase of traffic in the year 1842 over that of the preceding year, amounted to 500,870*l.*; in the year 1844 to768,337*l.*; in 1845, to 1,058,340*l.*; in 1846, to 1,020,650*l.*; in 1847, to 1,285,780*l.*; in 1848, to 1,083,335*l.*; in 1849, to 954,810*l.*; in 1850, to 1,744,168*l.*; in 1851, to 1,809,925*l.*; and in 1852 the increase over the preceding year amounted to 520,400*l.* The great increase of traffic in the year 1850 was due in a great measure to the encouragement given by railway companies to excursion traffic in that year; and the increase in 1851 chiefly to that cause in connexion with the Great Exhibition. The year 1852 shows a comparative falling off in the increase of traffic as compared with the average of ten preceding years to the amount of 554,252*l.* From this it would appear that the efforts made to force the traffic during the past two years above the ordinary increase had reacted on the traffic of 1852, and thus reduced the expected increase of traffic in that year.

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* From the London Civil Engineer and Architect's Journal, February, 1853.

At the end of the year 1842, 1510 miles of railway were open to the public; during the next year an additional length of 56 miles of new railway was opened for traffic; in 1844, a further length of 194 miles was opened; in 1845, 263 miles; in 1846, 593 miles; in 1847, 839 miles; in 1848, 975 miles; in 1849, 834 miles; in 1850, 1096 miles; in 1851, 280 miles, and in 1852 the published returns show an additional mileage of 378 miles. So far as the traffic is concerned, it does not appear that there can be much to complain of in respect of the aggregate amount of it on railways since they have been established, and were it not for the adverse interests operating at railway boards, the errors of engineers as to the cost of works and laying out of lines, the letting of large contracts at exorbitant prices by private agreement, excessive payments for land, the continual litigation both in and out of parliament, and the consequent unwarrantable expenditure on capital account, the traffic receipts would have been ample to pay fair dividends on the outlay.

The average traffic receipts per mile show the effect of opening within a period of four or five years so many miles of branch and competing lines of railway. During the year 1842, the gross receipts averaged 3113*l.* per mile; in 1843, 3083*l.* per mile; in 1844, 3728*l.* per mile; in 1845, 3469*l.* per mile; in 1846, 3305*l.* per mile; in 1847, 2870*l.* per mile; in 1848, 2556*l.* per mile; in 1849, 2302*l.* per mile; in 1850, 2227*l.* per mile; in 1851, 2281*l.* per mile; and in 1852, 2238*l.* per mile. This shows a falling off in the traffic per mile of about 30 per cent.; but during the past three years the receipts per mile have not been much under those of 1849.

The reduction in the receipts per mile would not be of much consequence, provided the average cost of constructing the railways was reduced in the same proportion as the traffic per mile—say from 34,000*l.* per mile to 23,000*l.* per mile, and so on in like manner with every additional line to the system; but, unfortunately, it appears that this would not suit engineers, contractors and other parties; and although some cheap railways have been constructed, the following will show that they have not had much effect on the average cost of the whole:—In 1842, the cost of railways then in operation, including working stock, &c., averaged 34,690*l.* per mile; in 1843, 36,360*l.*; in 1844, 35,670*l.*; in 1845, 35,070*l.*; in 1846, 31,860*l.*; in 1847, 31,700*l.*; in 1848, 34,234*l.*; in 1849, 35,214*l.*; in 1850, 35,229*l.*; in 1851, 35,058*l.*; and in 1852, 34,630*l.* About 5000 miles of additional railways and branches have been added to the system since 1845, at which time the average cost per mile was 35,070*l.*, being only about 440*l.* per mile more than the average cost of 1852. The stationary position of the average cost per mile shows clearly that the continued additions to the capital accounts of old and completed lines of railway far outweigh all the professed advantages of constructing thousands of miles of new railways at less cost than the old trunk lines.

The capital expended on the railways of which the traffic is published weekly amounted in July, 1842, to 52,380,100*l.*; in 1843, to 57,635,000*l.*; in 1844, to 63,489,100*l.*; in 1845, to 71,647,000*l.*; in 1846, to 83,165,100*l.*; in 1847, to 109,528,000*l.*; in 1848, to 148,200,000*l.*; in 1849, to

181,000,000*l.*; in 1850, to 219,762,700*l.*; in 1851, to 229,175,230*l.*; and in 1852, to 239,967,453*l.* The expenditure on the new and old lines above mentioned the traffic returns of which are not published weekly, amounts to about 8,626,100*l.*, making with the 239,967,453*l.*, a total of 248,593,553*l.* expended on 7338 miles of railway, being at the rate of 33,879*l.* per mile. Deducting 45 per cent. for working expenses from the gross receipts of 1852, will leave for interest and dividend 8,548,985*l.*; which on the capital expended would be at the rate of 3·44 per cent. per annum. It is probable that the amount to be divided among the holders of railway shares, bonds, and debentures, after the next half yearly meetings in February, will not be less than 4,500,000*l.*

An Investigation of the Strain upon the Diagonals of Lattice Beams, with the resulting Formulæ. By William Thomas Doyne, Assoc. Inst. C. E., and William Bindon Blood, A. B.*

In constructing a model for the purpose of illustrating practically the truth of the mathematical reasoning upon the strains to which the different parts of a lattice beam were subjected under the same and different forms of load, it was the object of the authors to reduce the investigation to as simple a form as possible; they therefore constructed the model with catenated top and bottom strings, connected together by diagonals, forming a single triangulation, purposely avoiding the more complex form of a number of lattices intersecting each other. The arrangement of the diagonals is such as to show, that with a beam supported at each end and loaded at the centre, or uniformly over its entire length, the strain upon the diagonals divides itself at the centre, and is transmitted through the two halves of the beams, in opposite directions, towards the ends, causing the diagonals in each half to act alternately as struts and ties; those acting as struts in the model being made of mahogany bars 14 inches long by 1½ inch wide and ½-inch thick, with their ends simply let into the top and bottom strings, but not made fast in any way; while the ties are made of light hoop iron chains, each in three parts, put together with loose pins passing through them, and fastened to the top and bottom by the iron pins which connect the parts of which they are formed; this arrangement preventing the possibility of the struts acting as ties and *vice versa.*

The length of the model between the points of support is 154 inches (12 ft. 10 in), the triangles formed by the lattice bars are equilateral, each side being 14 inches long, making the depth from centre to centre of the top and bottom 12·124 inches. Its total weight is 22 lbs., and any portion of it can be taken out, so that a dynamometer can be inserted, by which means the strains upon all the parts have been measured and compared with those calculated.

The following are the results (for a beam having a parallel top and bottom):—With a load at the centre, the horizontal strains are greatest at the centre, decreasing towards the ends, in the ratio of the distance from the centre, while the strains upon the diagonals are uniform throughout the beam. With an uniform load, the horizontal strains are greatest at the centre, decreasing towards the ends, in the ratio of the ordinates of a parabola, while the strains upon the diagonals commence at the centre, increasing towards the end, as their distances from the centre.

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* From the London Civil Engineer and Architect's Journal, January, 1853.

The course of reasoning by which these conclusions are arrived at is very simple. The value of the horizontal strains does not require proof here, and those upon the diagonals are easily deduced from them in the following manner :—With a beam supported at each end, and loaded at the centre, the horizontal strain commences at the point of support, increasing uniformly towards the centre, where the connecting rib between the top and bottom is continuous; but when, as in this case, there are intervals between the points of attachment, the increase is sudden at each point of attachment, but of equal value; it is, then, evident, that as the horizontal strains are produced by the diagonals, that by differentiating the known horizontal strains at the points of attachment of the diagonals, the amount of strain due to each diagonal is shown; in this case, the difference between the horizontal strains at each point of attachment is a constant number, consequently the strain upon the diagonals are uniform, or, in other words, the strain upon the diagonals are as the difference between the ordinates of two converging lines, which is the figure which would represent the strains upon the top and bottom.

Fig. 1.

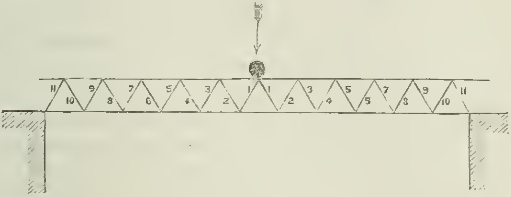
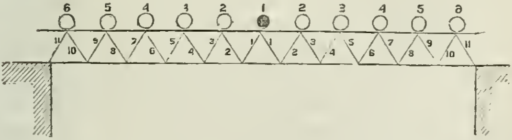


Fig. 2.



For the same reason it is evident, that with an uniform load the strains upon the diagonals decrease from the point of support, where they are greatest, towards the centre, as the differences between the ordinates of a parabola, which differences are the ordinates of two converging lines.

Or the same conclusions may be arrived at without a knowledge of the horizontal strains by tracing, through the medium of the resolution of forces, the strains produced upon the lattices by any given load; when it will appear, that with a load at the centre, as in fig. 1, one half is resolved in each direction, first through the struts 1, 1, thence into the ties 2, 2, and from thence into the struts 3, 3, and so on alternately through struts and ties until it reaches the point of support: the strain upon each lattice being uniform, and equal to half the load applied, increased by as much as the lattice bar is longer than the perpendicular of the triangle of which it is the hypothenuse. The horizontal strain produced at the points of attachment of each lattice, will also bear, to the strain upon the lattice, the ratio which the length of the base of the same triangle bears to the length of the lattice bar; and the total horizontal strain at any point will be the sum of the strains produced by all the lattices, between the point of support and that point which will give the horizontal strains, as decreasing from the centre to the ends, in the ratio of the ordinates of two converging lines—the premises which were the basis of the last mode of reasoning.

For a beam uniformly loaded, as in fig. 2, weight No. 1 will, in the same manner as in the last example, produce an uniform strain upon all the lattices from 1 to 11, equal in amount to one-half its own weight, increased in the ratio before mentioned; weight No. 2 will resolve the whole of its weight (subject to the same increase) through all the lattices from 3 to 11; weight No. 3, in like manner, will give a new strain from 5 to 11, and so on to the end, the strains accumulating, from the centre towards the ends, as the distance from the centre. Taking the sum of these strains at each point of attachment, the horizontal strains will be found to decrease from the centre towards the ends in the ratio of the ordinates of a parabola, as before assumed. The same reasoning is applicable to the usual lattice beam, where the lattices intersect one another at several points; in this case the horizontal strains are the same, except that they are distributed over a greater number of points of attachment, the strain at each point, however, bearing the same ratio to the others as in the case of the simple triangulation, but the amount is decreased in proportion as the number of points of attachment have been increased.

The following rules and formulæ are at once deducible from the foregoing:—With a load at the centre, the sum of the strains upon the lattices is equal to the horizontal strain at the centre, increased by as much as the lattice bars are longer than the bases of the triangles of which they form the hypothenuses, or the base of this triangle is to the hypothenuse as the horizontal strain at the centre is to the sum of the strains upon all the lattices between the centre and one end; and as in this case the strains upon the lattices are uniform, this total strain, divided by the number of lattices between the centre and the end, will give the strain upon each. For an uniform load, the sum of the strains upon the lattices bears the same ratio to the horizontal strain in the centre, but is differently distributed over them, as before shown; for in this case the whole strain divided by the number of lattices will give the strain upon that bar which is situated half way between the centre of the beam and the point of support, while the strain upon the bar at the point of support is double the strain so found, and the intermediate strains can be calculated accordingly. The strains upon the different parts of the model have been calculated according to these principles from the following formulæ:—

With a load at the centre, the horizontal strain at the centre is $s = \frac{W\,L}{4\,D}$, and at any other point $s = \frac{W\,L}{4\,D} \cdot \frac{2\,x}{L}$, where W = the weight, L = the length, D = depth, and x = the distance of the point from the abutment; and the strain upon any diagonal is $y = \frac{W\ b}{2\ D}$, where y = the strain, b = the length of the diagonal, and W D as before.

With an uniform load, the horizontal strain at the centre is $s = \frac{W\ L}{8\ D}$, and at any other point $s = \frac{W}{2\ D\ L}(L\ x - x^2)$, where x is the distance of the point from the abutment; and W, D, L, as before: and the strain upon any lattice is $y = W\ \frac{a\ b}{D\ L}$, where y = the required strain, a = the distance of the middle point of the lattice from the centre of the beam, b = the length of the lattice bar, and W, D, L, as before.

These formulæ refer to a beam of a single triangulation, such as the model, the strain upon each lattice decreasing where the lattices intersect one another in the exact ratio of their increased number. The following table shows, in adjacent columns, the strains upon the diagonals of the model, calculated by these formulæ, and those measured by the dynamometer, taken with the weight of the model alone, and also with weights applied in four different forms, by which it will be seen that the calculations agree in a remarkably close degree with the measured results.

Strains upon the Diagonals of the Model, as calculated by the Formulæ, and as indicated by the Dynamometer.

Number of lattice, reckoning from the centre, figs 1 & 2.	Strain with its own weight.		Strain with 77 lbs. at centre.		Strain with 14 lbs. at each point of top.		Strain with 14 lbs. at each point of bottom.		Strain with 7 lbs. at each point of top and bottom.	
	Indicated.	Calculated.	Indicated.	Calculated.	Indicated.	Calculated.	Indicated.	Calculated.	Indicated.	Calculated.
1	—	·6	—	44·6	—	8·7	—	·6	—	4·6
2	1½	1·7	45	45·7	9½	9·8	7	17·9	13	13·8
3	—	2·9	—	46·9	—	27·1	—	19·1	—	23·1
4	4	4·0	47	48·0	28½	28·25	34	36·3	31½	32·3
5	—	5·2	—	49·2	—	45·6	—	37·5	—	41·6
6	6	6·3	48½	50·3	46	46·7	54	54·8	50½	50·8
7	—	7·5	—	51·5	—	64·1	—	56·0	—	60·0
8	8½	8·7	51½	52·7	65½	65·3	73	73·4	69	69·3
9	—	9·8	—	53·8	—	82·5	—	74·5	—	78·5
10	11½	11·0	57½	55·0	87	83·7	95½	91·8	91	87·8
11	—	12·1	—	56·1	—	101·0	—	92·9	—	97·0

By the application of these principles to practice, in bridges or other beams, the correct proportion that each lattice bar should bear to the remainder of the girder is easily ascertained, as also the dimensions of the rivets which connect the lattices with the top and bottom.

If the beam is required to carry an uniform stationary load only, then the lattices may be infinitely small at the centre, increasing in strength or number towards the ends, as their distance from the centre. If for a load at the centre only, the lattices should be of uniform strength throughout. If, however, as is generally the case in practice, the beam is required to carry both these descriptions of load, as well as one at any other point, then at the centre the lattices should be of such dimensions as to resist the strain produced by the greatest load which can be applied at the centre or at any other point, and to increase towards the ends, so as to meet the highest strains produced by an uniform load.

For girders, having boiler plate or other description of solid sides, the same principles apply, and point out, that for a load at one point only (leaving out of consideration, as in all these other cases, the weight of the beam itself,) the dimensions of the sides, and the connecting rivets, should be uniform throughout; while for an uniform load, the sides and rivets should increase in strength from the centre towards the ends, in the ratio of the ordinates of two converging lines; the correct proportions for any other description of load being also easily estimated by an extension of the same principles.

To be Continued.

LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

Supreme Court of the United States.

Lead Pipe Case.

Thomas Otis Le Roy & David Smith, *Plffs. in er.* *vs.* Benjamin Tatham, Jr., George N. Tatham, and Henry B. Tatham.	*In error to the Circuit Court of the United States for the Southern district of New York.*

This was an action at law, originally tried at New York, before Mr. Justice Nelson, and a jury, in April, 1849. The suit was instituted by the Messrs. Tatham, assignees of John and Charles Hanson, inventors of certain improvements in the manufacture of lead pipe. They alleged that the defendants had infringed upon their rights, under the patent, and had injured them to the amount of $20,000.

A verdict was rendered for the plaintiffs for the sum of $11,748. The case was carried by writ of error, to the Supreme Court of the United States. It was argued before that Court in December last, by Mr. Staples and Mr. Cutting, for the plaintiffs, and by Mr. Gillett and Mr. Noyes, for the defendants.

The facts of the case and the points of argument are fully set out in the opinions delivered.

Mr. Justice McLean delivered the opinion of the court.

This is a case on error, from the circuit court of the Southern district of New York.

The action was brought in the circuit court, to recover damages for an alleged infringement of a patent for new and useful improvements in machinery, for making pipes and tubes from metallic substances.

The declaration alleged that John and Charles Hanson of England were the inventors of the improvements specified, on or prior to the 31st of August, 1837; that on the 10th of January, 1840, the Hansons assigned to H. B. and B. Tatham, two of the defendants in error, the full and exclusive right to said improvements; that on the 29th of March, 1841, letters patent were granted for the improvements to the Tathams as the assignees of the Hansons; that afterwards H. B. and B. Tatham assigned to G. N. Tatham, the remaining defendant in error, an undivided third part of the patent.

On the 14th of March, 1846, the said letters patent were surrendered, on the ground that the specifications of the improvements claimed were defective, and a new patent was issued, which granted to the patentees, their heirs, &c., for the term of fourteen years, from the 31st of August, 1837, the exclusive right to make and vend the improvements secured. The declaration states the patent was of the value of fifty thousand dollars; and that the defendants below had made and vended lead pipe, to the amount of two thousand tons, in violation of the patent, and to the injury of the plaintiffs, twenty thousand dollars.

The defendants pleaded not guilty; the defendant Lowber did not join in the plea, but permitted judgment to be entered against him by default. On the trial certain bills of exceptions were taken to the instructions of the court to the jury, on which errors are assigned.

The schedule which is annexed to the patent and forms a part of it, states, that the invention consists "in certain improvements upon, and additions to, the machinery used for manufacturing pipes and tubes from lead or tin, or an alloy of soft metals capable of being forced by great pressure from out of a receiver, through or between apertures, dies, and cores, when in a set or solid state, set forth in the specification of a patent granted to Thomas Burr, of Shrewsbury, in Shropshire, England, dated the 11th of April, 1820." After describing Burr's machine, its defects, and the improvements made on it as claimed, the patentees say, "pipes thus made are found to possess great solidity and unusual strength, and a fine uniformity of thickness and accuracy of bore is arrived at, such as, it is believed, has never before been attained by any other machinery."

"The essential difference in the character of this pipe which distinguishes it, as well as that contemplated by Thomas Burr, from all other heretofore known or attempted, is, that it is wrought under heat, by pressure and constriction, from set metal; and that is not a casting formed in a mould."

And they declare, "We do not claim as our invention and improvement any of the parts of the above described machinery, independently of its arrangement and combination above set forth. What we do claim as our invention, and desire to secure is, the combination of the following parts above described, to wit, the core and bridge or guide piece, with the cylinder, the piston, the chamber and the die, when used to perform pipes of metal, under heat and pressure, in the manner set forth, or in any other manner substantially the same."

The plaintiffs gave in evidence certain agreements between the defendants, showing the manufacture of lead pipe by the defendant Lowber, for the defendants Leroy and Smith. And also evidence tending to prove that the said John Hanson and Charles Hanson were the original and first inventors of the improvement described in the said letters patent; that the invention and discovery therein described was new and useful; that the lead pipe manufactured thereby, was superior in quality and strength, capable of resisting much greater pressure and more free from defects than any pipe before made; that in all the modes of making lead pipe previously known and in use, it could be made only in short pieces, but that by this improved mode it could be made of any required length, and also of any required size; and that the introduction of lead pipe made in the mode described, had superseded the use of that made by any of the modes before in use, and that it was also furnished at a less price."

"And the plaintiffs also gave evidence tending to prove that lead, when recently become set, and while under heat and extreme pressure in a close vessel, would reunite perfectly, after a separation of its parts; and that in the process described in the said patent, lead pipe was manufactured by being thus separated and reunited; and that the said John and Charles Hanson were the first and original discoverers thereof; and that such discovery, and its reduction to a practical result in the mode described in said letters patent, was useful and important."

"And the plaintiffs also gave evidence conducing to prove that the improvement described in the letters patent was the same invention and discovery which had been made by the said John and Charles Hanson, and for which letters patent had been granted to them in England, and subsequently in this country, to the Tathams, as recited in the letters patent."

"And the plaintiffs also gave evidence conducing to prove that they had been ready and willing, and had offered to sell the said invention within eighteen months succeeding the issuing of said letters patent to them, and also since; and had, within the said eighteen months, sold the same for a large portion of the United States."

The defendants' counsel then read in evidence from the *Repertory of Arts*, vol xvi. page 344, the description of the patent to the Hansons dated 31 August, 1837. They also read in evidence the patent issued upon the application of the plaintiffs to the Patent Office, containing another specification, which was annexed to the patent surrendered. And also they read the specification of Thomas Burr's patent of 11 April, 1820. Also a patent granted to George W. Potter, described in the *Journal of the Franklin Institute*, vol. xii. published in 1833; they also read the specification of a patent granted in England to Bush and Harvey on 5 Dec. 1817; and also the specification of a patent granted in England to Joseph Bramah on 31 Oct. 1797.

Evidence was also given to show that the combination of machinery for making lead pipe, described in public works as having been invented by Burrows Titus, by George W. Potter, by Jesse Fox, by John Hague, and by Joseph Bramah, were substantially the same as that used by the plaintiffs; that the combination of machinery, patented as herein before stated, by Bush and Harvey, for making pipes of clay, and that used for making maccaroni, were substantially the same as that described in the plaintiffs' patent.

In their charge to the jury the court said, "they, the plaintiffs, also state that they do not claim any of the parts of the machinery, the cylinder, core, die or bridge, but that they claimed the combination when used to form pipes of metal, under heat and pressure, in the way they have described. There can be no doubt that if this combination is new, and produces a new and useful result, it is the proper subject of a patent." The result is a new manufacture. And even if the mere combination of machinery in the abstract is not new, still, if used and applied in connexion with the practical development of a principle, newly discovered, producing a new and useful result, the subject is patentable. In this view, the improvement of the plaintiffs is the application of a combination of machinery to a new end; to the development and application of a new principle, resulting in a new and useful manufacture. That the discovery of a new principle is not patentable, but it must be embodied and brought into operation by machinery so as to produce a new and an useful result. Upon this view of the patent, it is an important question for the jury to determine, from the evidence, whether the fact is established on which the alleged improvement is founded, that lead in a set, or semi-solid state, can thus be reunited or welded after separation. To this instruction the defendants excepted.

It was also objected that the plaintiffs' patent was invalid for want of originality; that the invention had been before described in public works, and Bramah, Hague, Titus, Fox, and Potter, were relied on by the defendants.

To this it was replied, by the court, "that in the view taken by the court in the construction of the patent, it was not material whether the mere combinations of machinery referred to were similar to the combination used by the Hansons, because the originality did not consist in the novelty of the machinery, but in bringing a newly discovered principle into practical application, by which a useful article of manufacture is produced, and wrought pipe made as distinguished from cast pipe." To this charge there was also an exception.

The word principle is used by elementary writers on patent subjects, and sometimes in adjudications of courts, with such a want of precision in its application, as to mislead. It is admitted that a principle is not patentable. A principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an exclusive right. Nor can an exclusive right exist to a new power, should one be discovered in addition to those already known. Through the agency of machinery a new steam power may be said to have been generated. But no one can appropriate this power exclusively to himself, under the patent laws. The same may be said of electricity, and of any other power in nature which is alike open to all, and may be applied to useful purposes by the use of machinery.

In all such cases, the processes used to extract, modify and concentrate natural agencies, constitute the invention. The elements of the power exist; the invention is not in discovering them, but in applying them to useful objects. Whether the machinery used be novel, or consist of a new combination of parts known, the right of the inventor is secured against all who use the same mechanical power, or one that shall be substantially the same.

A patent is not good for an effect, or the result of a certain process, as that would prohibit all other persons from making the same thing by any means whatsoever. This by creating monopolies would discourage arts and manufactures, against the avowed policy of the patent laws.

A new property discovered in matter, when practically applied, in the construction of a useful article of commerce or manufacture, is patentable; but the process through which the new property is developed and applied must be stated, with such precision as to enable an ordinary mechanic to construct and apply the necessary process. This is required by the patent laws of England and of the U. States, in order that when the patent shall run out the public may know how to profit by the invention. It is said in the case of the Househill Company vs. Neilson, Webster's patent cases 683, "a patent will be good, though the subject of the patent consists in the discovery of a great, general, and most comprehensive principle in science or law of nature, if that principle is by the specification applied to any special purpose, so as thereby to effectuate a practical result and benefit not previously attained." In that case Mr. Justice Clerk in his charge to the jury said, " the specification does not claim any thing as to the form, nature, shape, materials, numbers, or mathematical character of the vessel or vessels in which the air is to be heated, or as to the mode of heating such vessels," &c. The patent was for "the improved application of air to produce heat in fires, forges, and furnaces, where bellows or other blowing apparatus are required."

In that case, although the machinery was not claimed as a part of the invention, the jury were instructed to inquire, " whether the specification was not such as to enable workmen of ordinary skill to make machinery or apparatus capable of producing the effect set forth in said letters patent and specification." And that in order to ascertain whether the defendants had infringed the patent, the jury should inquire whether they "did by themselves or others, and in contravention of the privileges conferred by the said letters patent, use machinery or apparatus substantially the same with the machinery or apparatus described in the plaintiffs' specification, and to the effect set forth in said letters patent and specification."

So it would seem that where a patent is obtained, without a claim to the invention of the machinery through which a valuable result is produced, a precise specification is required, and the test of infringment is, whether the defendants have used substantially the same process to produce the same result.

In the case before us, the court instructed the jury that the invention did not consist, "in the novelty of the machinery, but in bringing a newly discovered principle into practical application, by which a useful article of manufacture is produced, and wrought pipe made as distinguished from cast pipe."

A patent for leaden pipes would not be good, as it would be for an effect, and would, consequently, prohibit all other persons from using the same article, however manufactured. Leaden pipes are the same, the metal being in no respect different. Any difference in form and strength must arise from the mode of manufacturing the pipes. The new property in the metal claimed to have been discovered by the patentees belongs to the process of manufacture, and not to the thing made.

But we must look to the claim of the invention stated in their application by the patentees. They say, "we do not claim as our invention and improvement any of the parts of the above described machinery, independently of their arrangement and combination above set forth." "What we claim as our invention, and desire to secure by letters patent, is the combination of the following parts above described, to wit, the core and bridge or guide piece, the chamber, and the die, when used to form pipes of metal, under heat and pressure, in the manner set forth, or in any other manner substantially the same."

The patentees have founded their claim on this specification, and they can neither modify nor abandon it in whole or in part. The combination of the machinery is claimed, through which the new property of lead was developed, as a part of the process in the structure of the pipes. But the jury were instructed "that the originality of the invention did not consist in the novelty of the machinery, but in bringing a newly discovered principle into practical application." The patentees claimed the combination of the machinery as their invention in part, and no such claim can be sustained without establishing its novelty—not as to the parts of which it is composed, but as to the combination. The question whether the newly developed property of lead used in the formation of pipes might have been patented, if claimed, as developed, without the invention of machinery, was not in the case.

In the case of Bear *vs.* Smallwood, Curtis 24, R. 1., Mr. Justice Story said, "He (the patentee) says that the same apparatus, stated to this last claim, has been long in use, and applied, if not to chairs, at least in other machines to purposes of a similar nature. If this be so, then the invention is not new, but at most is an old invention, or apparatus or machinery applied to a new purpose. Now I take it to be clear, that a machine or apparatus, or other mechanical contrivance, in order to give the party a claim to a patent therefor, must in itself be substantially new. If it is old and well known, and applied only to a new purpose, that does not make it patentable."

We think there was error in the above instruction that the novelty of the combination of the machinery, specifically claimed by the patentees as their invention, was not a material fact, for the jury, and that on that ground the judgment must be reversed. The other rulings of the court excepted to we shall not examine, as they are substantially correct.

Chief Justice Taney, and Justices Catron and Daniells, concurred. Justices Wayne and Grier dissented, and Mr. Justice Nelson delivered a very able and elaborate dissenting opinion, which will be given in the next number of the *Journal.*

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Composition of the Substances employed by the Chinese in the Manufacture of Porcelain. By MM. Ebelmen and Salvetat.*

The authors have analyzed a series of substances, collected in China by a resident Catholic priest, Father Ly, which there form the material for the manufacture of porcelain. Some other substances, which are especially used for decoration, were brought from Canton by M. Itier. It results from this investigation that—

1. The kaolins and the *Pe-tun-tse* of the Chinese completely resemble the substances employed by the Europeans for the same purpose. The Chinese kaolins have undoubtedly originated from the decomposition and disintegration of granite rocks. The pe-tun-tse is identical in its mineralogical properties with compact felspar or hornstone, and resembles the pegmatite of Limosin. The pe-tun-tse consists of hornstone reduced to a fine powder, and formed into cakes, which together with the kaolins give the porcelain mass.

2. It appears that the mechanical arrangements for the production of the pastes are the same as with us.

3. The Chinese porcelain clays are more readily fusible than the European, and the same is the case with the Chinese glazes.

The greater fusibility and the greenish color of the Chinese porcelain appears to be owing to an addition of lime to the pe-tun-tse. The pe-tun-tse alone might perhaps serve as a glaze for the porcelain manufactured in France. The Chinese porcelains have been generally considered as peculiarly hard, but they are certainly baked at far lower temperatures than those at Sèvres and Meissen; they are harder than the porcelains with lead glaze. All the following analyses and statements refer merely to the manufacture of porcelain at King-te-tching in Kaiang-si, at which place there are, according to d'Entrecolles, more than 3000 porcelain furnaces and a population of 100,000. Father Ly gives the following account of the manufacture of the porcelain:—

"All the materials employed in the manufacture of porcelain in China are stones which are dug out of the soil or from rocks, with the exception of the *kao-ling* from Tong-kang and from Sy-kang, which are sands; they are suspended in water, in order to obtain the finest powder. All the stones are ground to powder, then diffused in water, in which they are stirred with a rod, and the upper layers of the water drawn off; these deposit the mineral in an exceedingly fine state of division, of which the pastes are formed. All the pastes are brought to King-te-ching into the houses of the workmen, who diffuse them again in water, pass the masses through sieves, dry the sediment somewhat, and then work it. The materials do not occur together in one spot in China; some are brought from very distant places. Some come from Khy-men-hien, others from

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* From the London Chemical Gazette, No. 216.

Fou-leang-hien, others from Yu-kan-hien, and even from the province Hou-pe, as for instance the *chy-kao*. At King-te-ching all the finely worked materials and pastes can be bought; but it is frequently necessary to search far and wide in order to procure the raw materials. I have succeeded in obtaining twelve different materials, of which however neither one alone furnishes porcelain. The workmen told me, some of the materials furnished the bone for the porcelain; this is the case with the *kao-lings* from Tong-kang and Sy-kang; others yield the body for the porcelain, as the masses from San-pao-p'ong, from Yu-kan-hien, &c. If the vessels be formed merely from kao-ling, they crack in the fire, because the kao-ling is too hard; if they are made from the other materials without kao-ling, they dissolve in the fire (like flowers which fade in the heat of the sun), because their nature is too weak, and they cannot stand twenty-four hours' fire. I distinguish four kinds of porcelain. To prepare the first, or best kind, 1 lb. of kao-ling is mixed with 2 lbs. of material from Khy-men; for the second, 4 lbs. *say-pe* from Tong-kang and 2 lbs. of *kao-ling* from Sy-kang; for the third, 2 lbs. of material from San-pao-p'ong and 1 lb. of *kao-ling* from Tong-kang; for the fourth kind, 1 lb. of material from Yu-kan-hien with 1 lb. of *hoa-chy* and 1 lb. of *kao-ling* from Sy-kang."

It is quite evident from this letter, that the Chinese, in their manufacture of porcelain, proceed exactly in the same way as we do. They dig up and lævigate the kaolins, the substances from Tong-kang and Sy-kang, and mix them with finely pulverized and lævigated quartz and felspar sand.

Kaolin *from Tong-kang*, *Province Fou-leang-hieng.*—The crude kaolin furnished by elutriation, 43 per cent. of clay dried between 95° and 104° F., does not effervesce with acids, and resembles the kaolin of St. Yrieix, which is used at Sèvres; it does not fuse in the porcelain furnace, but contracts very much. The residue distinctly shows it to originate from a granitic rock, probably from pegmatite.

Kaolin *from Sy-kang*, *Province Fou-leang-hieng.*—This contains a very large amount of quartz, and furnishes on elutriation only 7 per cent. of clay. The residue consists in quartz granules and partially decomposed crystals of a rose-colored felspar and golden mica.

The following table of the analyses show the relation of the constituents compared with those of the clay of St. Yrieix. The analyses are made with the washed out clay:—

	Kaolin from Tong-kang.	from St. Yrieix.	from Sy-kang.	Quartzose kaolin from St. Yrieix.
Water,	11·2	12·62	8·2	7·2
Silica,	50·5	48·37	55.3	56·9
Alumina,	33·7	34·95	30·3	31·6
Peroxide of Iron,	1·8	1·26	2·0	0·5
Magnesia,	0·8	traces	0·4	
Lime,	..	..	..	0·5
Potash,	1·9	2·40	1·1	3·4
Soda,	..		2·7	
Loss,	0·1	0·40		
	100·0	100·00	100·0	100·1

The great similarity of the Chinese kaolins to those of St. Yrieix is sufficiently evident from these analyses. The French kinds are obtained from decomposed layers of pegmatite, in the neighborhood of which both hard and partially kaolinized felspathic rock occur. The Chinese kaolins undoubtedly originate from granite.

In the following tables are arranged together the results of the analyses of those substances, which, according to the expression of the Chinese workmen, constitute the body of the porcelain. The above kaolins, which impart to the porcelain its infusibility in the fire, they look upon as the bone of the porcelain; all those rocks, which, on the contrary, serve to produce the requisite fusibility of the kaolins and the translucency of the porcelain, are termed the body of the porcelain; they are all of them hornstone, of a conchoidal or splintery fracture, with the hardness peculiar to this mineral. The analyses, so far as it was possible, were made with the same rock in the crude and in the prepared state. The following are the results:—

	Khy-men-hien		San-pao-p'ong.		Siao-ly	
	1. Crude material.	1*. Prepared.	2. Crude material.	2*. Prepared.	3. Crude material.	3*. Prepared.
Loss in the fire,	2·91	3·05	3·10	3·05	3·76	3·25
Silica,	76·20	76·26	74·90	75·00	76·30	76·41
Alumina,	13·60	14·20	14·00	14·15	13·15	13·90
Peroxide of iron,	traces	traces	0·80	0·10	0·85	0·90
Oxide of manganese,	traces	0·35	0·20	traces	0.30	traces
Lime,	0·12	traces	traces	0·12	traces	0·35
Magnesia,	traces	traces	traces	0·15	traces	traces
Potash,	3·28	3·00	3 00	3·10	3·10	3·00
Soda,	5·05	4 00	3·90	3·04	2·17	2·50
	101·19	100·86	99·90	99·71	99·53	100·31

	Yu-kan-hien.			Say-pe.	
	4. Crude material.	4*. Prepared.	4†. Prepared.	5. Crude material.	5*. Prepared.
Loss in the fire,	2·40	2·40	2·60	2·00	2·50
Silica,	74·70	77·00	74·40	75·40	73·60
Alumina,	15·90	15·70	15·00	16·00	17·80
Peroxide of iron,	..	..	traces	0·10	
Oxide of manganese,	0·10	..	..	traces	traces
Lime,	0·10	0·20	0·10	0·40	0·50
Magnesia,	0·20	..	..	traces	0·10
Potash, Soda,	6·40	4·70	6·90	6·00	5.50
	99·80	100·00	99·00	99·90	100·00

The external properties of these rocks, the analyses of which are given in the preceding tables, are as follows:—

1. *Rock from Khy-men-hien.*—Large fragments of a grayish-white rock, of a conchoidal and scaly fracture, spec. grav. 2·64, containing interspersed crystals of quartz, and fusing before the blowpipe into a white enamel; the pieces are coated with dendritic figures of oxide of manganese.

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* All those numbers with a * are the prepared materials of the same number; 4 †, a pulverized mixture of rock from Khy-men and rock from Yu-kan-hien, completely prepared.

This material is likewise employed by the Chinese as a glaze; a piece of porcelain, coated with it, and baked in the usual way at Sèvres, acquired a beautiful glaze. Its composition is very similar to that of pegmatite, which is used for glaze in France; the powder obtained by lævigation had the spec. grav. 2.597, and the following composition:—

Water,	0·40
Silica,	76·10
Alumina	15·37
Peroxide of iron,	0·13
Lime,	0·17
Magnesia,	traces
Potash,	2·84
Soda,	4·58
Loss,	0·41
	100·00

2. *Rock from San-pao-p'ong in Fou-leang-hien.*—This is of a gray color, with a splintery fracture, and exhibits, like the preceding one, dendritic figures of oxide of manganese on the fracture. It appears to be somewhat less fusible than the preceding one.

3. *Rock from Siao-ly in Fou-leang-hien.*—A greenish hornstone, with a splintery fracture, and the spec. grav. 2·66.

Some scales of white mica are perceptible in it, and at some places little cubes of iron pyrites. It fuses, like the preceding rock, in the fire of the porcelain furnace.

4. *Material from Yu-kan-hien.*—A grayish rock, with a splintery uneven fracture, with some reddish veins; spec. grav. 2·64; fusibility and appearance nearly like the preceding.

5. *Rock from Say-pe in Tong-kang.*—A greenish hornstone, with a conchoidal and splintery fracture; contains some crystals of iron pyrites; spec. grav. 2·64; and closely resembles the hornstone from Siao-ly (3.); its fusibility appears also to be about the same.

It is remarkable that the Chinese hornstone contains a perceptible amount of water, which is not expelled at 212°.

Hoa-chy.—The substances comprised under this name exhibit the greatest differences according to the localities whence obtained. The authors have examined three kinds; the first is from the collection of Father Ly, the second from the Sèvres collection, and the third was procured from M. Itier.

I. *Hoa-chy from Ngan-jing hien.*—That sent by Father Ly is dug out from the soil and lævigated; according to his statement, it furnishes the inferior quality of porcelain clays when mixed with the above analyzed hornstones and kaolins, and it likewise differs from all hitherto known. In the Sèvres collection there are two samples; one consists of the elutriated clay, the other forms the residue; the first is soft to the touch, has a somewhat yellow color, and does not effervesce with acids; the other consists of agglomerated pieces, of the same color as the clay, mixed with a large number of coarse crystalline particles of quartz.

In the collection of the Ecole des Mines, the authors found the rock which probably furnishes the hoa-chy on its decomposition; it is labelled "*Rock from the Mountains of Ngan-jing-lao-chan*," and is a yellow crumbling mass, in which is seen a large number of bipyramidal crystals of quartz. This rock is therefore not a sedimentary one, but a quartzose porphyry. Analysis I. is that of the clayey portion, II. of the sandy portion in the Sèvres collection, III. that of the mineral from the Ecole des Mines. Its difference in composition is owing to its being in a less advanced state of disintegration:—

	I. Clayey portion.	II. Sandy portion.	III.
Water, (loss in the fire,) . . .	9·0	2·9	5·00
Silica, ...	65·0	85·0	70·00
Alumina, ...	22·3	9·2	20·95
Peroxide of iron, ...	2·5	0·6	0·80
Lime, ...	traces	..	traces
Magnesia, ...	traces	traces	traces
Alkalies and loss, ...	1·2	2·3	
Potash, ...	..	..	3·20
Soda, ...	..	..	0·90
	100·0	100·0	100·85

II. *Hoa-chy from Koansi* has been placed among the serpentine rocks by Brongniart. According to the examination of the authors, it does not belong there; its composition rather resembles that of halloysite, from which it essentially differs only in the amount of water. Two samples, I. hoa-chy from Koan-sy, II. hoa-chy from Su-chu-en, furnished on analysis—

	I. Hoa-chy from Koan-sy.		II. Hoa-chy from Su-chu-en.
Loss in the fire, ...	16·50	16·50	15·52
Silica, ...	48·00	44·00	45·00
Alumina, ...	32·00	38·50	37·10
Peroxide of iron, ...	traces	traces	1·20
Lime, ...	traces	traces	traces
Magnesia, . . .	25·0	1·40	2·10
Alkalies, ...	1·00	0·64	0·52
	100·00	101·04	101·44

III. *Hoa-chy from Oia-tsia*, sent by M. Itier, consists of large radiate fragments, of a fibrous texture, and with a white fracture. The fibrous nuclei have all the external properties of tremolite; interiorly they are combined with a very soft substance, which appears to be soapstone; the fibrous portion however is by far the most predominant. On being treated with hydrochloric acid, a violent disengagement of carbonic acid results, and the liquid contains lime and magnesia. Its specific gravity is 2·90; it is undoubtedly a mixture of white amphibole with hydrated trisilicate of magnesia, of which soapstone is composed. In the hoa-chy which has not been purified, this mixture occurs together with a certain quantity of dolomite, the amount of which however appears to be variable. According to Beudant, the specific gravity of tremolite is 2·9–3·15, that of steatite 2·6–2·8. This hoa-chy does not fuse nor soften in the porcelain furnace;

it becomes very hard in it, and after the baking scratches glass. On analysis it furnished—

		Oxygen.
Loss in the fire,	1·27	
Silica,	60·79	32·26
Lime,	10·25	2·29
Magnesia,	26·50	10·26
Alumina and iron,	0·40	
	99·21	

Prepared Materials.—The following analyses relate to the pastes prepared by the Chinese, and forwarded by Father Ly, and which on baking furnish the Chinese porcelain. This gentleman collected several mixtures for porcelain of different qualities. Of the following three kinds of best and better quality, experiments which were made in the furnaces at Sèvres have shown that the difference in the quality of these three masses is due to the more or less yellow color which they acquire in the baking. The mass of the first quality burnt very white, whilst the last sample after the baking was perceptibly yellow.

First Quality, (labelled *B. a.*)—This mass is yellowish-white, loses water on calcination, and is partially decolorized; in the porcelain furnaces of Sèvres it burnt perfectly white. It does not effervesce on treatment with acids; hydrochloric acid deprives it of a small quantity of peroxide of iron and alumina, with a trace of manganese. It gave on analysis—

	Crude mass.	Material supposed to have been calcined.
Water,	7·7	
Silica,	63·6	69·6
Alumina,	21·8	23·6
Peroxide of iron,	1·1	1·2
Lime,	0·3	0·3
Magnesia,	0·2	0·2
Oxide of manganese,	0·1	0·1
Potash,	3·0	3·3
Soda,	2·8	2·9
	100·6	100·6

It is highly probable from this analysis that the mass is a mixture of equal parts of chert from Khy-men-hien and kaolin from Tong-kang. The calculation then gives the following composition:—

Water,	7·7
Silica,	63·4
Alumina,	22·7
Peroxide of iron, Lime, Magnesia,	1·1
Potash,	2·6
Soda,	2·5
	100·0

Mass of Second Quality, (labelled *B. e.*)—It consists, according to Ly's statement, of 2 lbs. of material from Khy-men, 4 lbs. of say-pe from Tong-kang, and 2 lbs. of kaolin from Sy-kang, mixed with 2 lbs. of the mass from San-pao-p'ong or Siao-ly. It is probable that the information which

Father Ly gives was obtained from a source which is not trustworthy. According to these statements, the kaolin could only constitute 20 per cent. of the mixture, which would not be very plastic, as the kaolin from Sy-kang contains a large amount of quartz. The analysis gave—

	Crude paste.	Supposed to be baked.
Water,	7·05	
Silica,	65·88	70·0
Alumina,	20·88	22·2
Peroxide of iron,	1·24	1·3
Lime,	0·72	0·8
Magnesia,	traces	traces
Potash,	3·36	3·6
Soda,	2·54	2·7
	101·67	100·6

Third Quality, (labelled *B. i.*)—This mass is said to be formed of 2 lbs. of paste from Sang-pao-p'ong, 1 lb. kaoling from Tong-kang, or of 2 lbs. of material from Yu-kang with 1 lb. kaoling from Sy-kang, or with 1 lb. say-pe or mixture from Hoa-chy. The analysis furnished—

	Crude paste.	Supposed to be baked.
Water,	6·7	
Silica,	68.7	37.3
Alumina,	18·1	19·3
Peroxide of iron,	1·8	2·0
Lime,	6·6	0·6
Magnesia,	traces	
Potash,	2·4	2·5
Soda,	2·2	2·3
	100·5	100·0

The articles manufactured from 1 were very neatly worked, translucent, with a bluish tint; those from 2 were thicker, more blue and less translucent; those from 3 were of a coarse shape, very heavy, scarcely translucent, and with the glaze full of holes.

Plates for the ordinary Porcelains, (labelled *B. o.*)—According to Ly, these are prepared from the residues of the several kinds of pastes, and kaolin from Sy-kang. Their composition is—

	Crude paste.	Paste freed from water.
Water,	9·25	
Silica,	62·80	68·94
Alumina,	19·41	21·30
Peroxide of iron,	3·12	3·42
Lime,	1·04	1·14
Magnesia,	traces	traces
Potash,	3·12	3·42
Soda,	1·72	1·78
	100·46	100·00

The objects manufactured with it are translucent, but rather deserve the name of stoneware than porcelain. The shape is very crude, the glaze not uniform and with holes, the mass coarse and badly ground.

GLAZES.—According to Ly, the basis of the glaze is *yeou-ko*, that is enamel. This enamel is employed for glazing all porcelains; it is mineral, which is taken from the rocks of Tong-kang, Fou-keang-hien, and is prepared in the same manner as the rock from Khy-men. This yeou-ko is, according to the authors, likewise a hornstone, and related to those the analyses of which have been given above. A sample at the Museum at Sèvres forms a greenish rock with laminar fracture, in which are distributed some crystals of iron pyrites; spec. grav. 2·62. It fuses before the blowpipe to a white enamel. Employed as a glaze on the hard porcelain of Sèvres, it furnished satisfactory results, which were similar to those from Khy-men-hien. The following is the composition of the substance in the crude state, and as prepared by pulverization and elutriation :—

	Crude mineral.	Prepared mineral.
Water,	2·7	2·3
Silica,	75·9	75·9
Alumina,	13·9	14·2
Peroxide of iron,	0·7	0·8
Lime,	0·4	0·5
Oxide of manganese,	traces	0·3
Magnesia,	traces	traces
Potash,	2·9	2·8
Soda,	3·8	3·5
	100·3	100·3

The yeou-ko, or enamel of the Chinese, which is well adapted as glaze for the hard porcelain of Sèvres, is not sufficiently fusible for the Chinese, on which account they mix it with lime, and probably also with the ashes of plants. Father Ly writes that the herb *lang-tchy* is common everywhere in China. A heap is made of alternate layers of this herb and lime, which is then fired; after the burning of the lime, the whole is mixed, treated with water to cleanse it and remove the coarse particles, and mixed finally with yeou-ko. The plants employed are ferns; they leave 0·049 of a reddish ash, which has the following composition:—

Soluble substances,	19·5
Silica,	64·5
Alumina, peroxide of iron, phosphate of lime,	16·0
	100·0

The calcined lime which the authors examined contained a mere trace of substances insoluble in muriatic acid, and was for the greater portion converted into carbonate, but still turned litmus blue. The mixture of this lime with the ashes of the fern is called *yeou-hoe;* it contains only 4 per cent. of a residue insoluble in acids, and 94 per cent. of lime and carbonic acid. As the authors had no prepared glaze at their disposal, which would enable them to determine in what proportion the yeou-hoe was mixed with yeou-ko to prepare the glaze, they analyzed the glaze of two Chinese porcelain plates, and found—

Silica,	68·0	64·1
Alumina,	12·0	10·2
Peroxide of iron,	traces	traces
Lime,	14·0	21·0
Potash and soda,	6·0	5·1
	100·0	100·4

According to this, the amount of calcareous substance mixed with the hornstone is very considerable. To this large amount of lime is owing the ready fusibility of the glaze, and likewise the more or less distinctly blue color shown by the glaze of the Chinese porcelain. It had already been observed, that by the addition of lime to the glaze of the hard porcelain of Sèvres, a decidedly greenish-blue color resulted.

Chy-kao.—A mixture sent under this name by Farther Ly, is a beautiful white fibrous gypsum, containing 21 per cent. of water. According to Ly, this gypsum is a very necessary ingredient to the Chinese for the preparation of their mixtures. According to him, it comes from the mountains of Yu-tchheng-hien, in the province Hou-pe, and is used as an addition in the preparation of the masses, excepting the pastes formed of the kaolin from Tong-kong and Sy-kang, because the powder of all these substances will not form pastes without chy-kao. It is employed in the following manner: In the first place, the powder of the substances is mixed with water, then some chy-kao powder added, and the whole stirred with a rod. After some time the powder subsides, and the water becomes clear. Before the grinding, the chy-kao is placed in the fire, to burn it somewhat; its action however is always the same, whether burnt or not.

The authors observe, that the Chinese at Pekin, in order to render yellow turbid water clear, dip a crystal of alum into it, when all the turbidity is soon precipitated. In the above process the gypsum undoubtedly acts likewise only mechanically, facilitating the subsidence of the suspended particles, as it was not again met with either in the composition of the glazes or the pastes.

In general, the paste of the Chinese porcelain constantly contains more silica and alkalies than that of the European porcelain, and it is far more fusible. Cups from China became soft, and sunk entirely together in the furnaces used for the hard porcelain of Sèvres.

In conclusion, it is worthy of remark, that the Chinese have found that prepared pastes which have long been kept moist furnish the best porcelain; they are said to use mixtures which have been kept moist for a century. Supposing this to be true, it would be owing to the decomposition of the felspar ingredients.—*Ann. de Chim. et de Phys.*, vol. xxxi. p. 257.

(To be Continued.)

For the Journal of the Franklin Institute.

Notes of the Performance of the U. S. Steamer Saranac,

On her late cruize from Philadelphia to Para, Maranham, Pernambuco, Bahia, and Rio Janeiro, and from thence to Pensacola, via. Barbadoes.

Total quantity of coal received on board at Philadelphia and elsewhere,	1159¼ tons.
Total quantity consumed,	1099¼ "
" time during which steam was on boilers,	69 days 13 hours 20 min.
" " " " engines were in motion,	63 " 19 " 57 "
" cost of coals,	$10,517·37
Average cost of coal per ton,	$ 8·88
Distance run by observation,	11039 knots.
Coal per knot,	223 pounds.
Cost of coal per knot,	88·4 cents.

Z.

On the Arrangement of the Materials in the Blast Furnace, and the Application of the Waste Gases. By Mr. Samuel H. Blackwell.*

Continued from page 193.

The manner of taking off the gases at Dundyvan is as follows:—The furnace is 42 feet high, and 12 feet in diameter in the centre; it begins to contract at 12 feet from the bottom, to form the boshes and hearth,—the hearth being 7 feet wide at the bottom; and it also begins to contract at 8 feet from the top, which at the filling plate is eight feet wide. Below the contracted part last named, there are eight flues four feet high, and eighteen inches wide, placed at equal distances from each other, and leading into an annular chamber that extends round the furnace and is continued up to the filling plates, by which it is closed. The pipe for the passage of the gas is placed nearly at the top of this annular chamber. Sometimes the entrances to the flues are covered by a wrought iron cylinder, ten feet wide, resting on a flanch, let into the lining of the furnace at a depth of from five to six feet below the filling plates, so as to leave a circular space between the cylinder and the lining of about twelve inches width. Although this arrangement works satisfactorily, it is doubtful whether the cylinder is necessary, and, indeed, it is more than probable that it would be destroyed before the furnace had been long in blast. In many furnaces with open tops, from which the gases are now taken, the use of the cylinder has been abandoned altogether, as needless. Where not used, it is however quite necessary that the openings into the flues should be at a sufficient depth from the top of the furnace, to prevent the possibility of the admixture of the gas with atmospheric air. To effect this, a depth of ten, twelve, or even fifteen feet, is sometimes adopted with advantage. The gases pass off more readily at these depths, in consequence of the greater resistance of the superincumbent materials, and they are in a more suitable state for heating purposes.

The most able investigations of the nature of the gases of the blast furnace are those of M. Ebelmen, and almost all the knowledge we possess of their chemical composition will be found in a paper communicated by him to the *Annales des Mines*, in 1851, and which contains, not merely a *resumé* of M. Ebelmen's own investigations, but also an examination of those of Messrs. Bunsen and Playfair, as reported to the British Association.

From M. Ebelmen's experiments it would appear that the first action of the blast upon its entrance into the furnace through the tuyeres is to produce carbonic acid, by the union of the oxygen of the atmosphere with the carbon of the coke: this is accompanied with the intense heat required for the fusion of the iron ore. The carbonic acid, as it passes upwards, is converted into carbonic oxide, by contact with the carbon of the incandescent coke above the zone of fusion. As the carbonic oxide ascends higher in the furnace, it acts as a reducing agent upon the oxide of iron of the ore, by uniting with the oxygen, by which a considerable portion is again converted into carbonic acid. The gases emerging from the top of the furnace are therefore, from the result of the chemical action now detailed, and also from the carbonic acid liberated from the limestone used as flux, more highly charged with carbonic acid than those which may be taken off at a lower point; and consequently, to the extent of this greater proportion of carbonic acid they possess less heating power. Where, therefore, only a portion of the gases are taken off, as in the case of open tops, the depth of the flue is important, in reference to the quality of the gas taken off, as well as to its freedom from any admixture with atmospheric air.

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* From the London Journal of Arts and Sciences, January, 1853.

In this notice of Ebelmen's experiments, all attention to the composition of the gases, except in reference to their heating power, is purposely omitted.

The results, at which we may be now said to have fully arrived, are the following:—1st, That the waste gases may be used with great economy in raising steam and heating the blast. 2d, That they must be taken off in such a manner as to prevent their mixing with atmospheric air before they arrive at the place where they have to be applied. 3d, That this may be effected in two ways, either by placing the openings for taking them off sufficiently below the surface of the materials in the furnace, or by closing the filling part entirely. 4th, That the first plan is the most desirable where gray iron is requisite; but, where adopted, it is necessary that a powerful draft should be obtained by a sufficiently lofty stack. 5th, That, when thus taken off as gas, they can be conveyed to any distance proportionable to the power of draft available, without losing any of their calorific power beyond that lost by simple radiation,—the whole of the calorific power to be obtained from their combustion being economized, until atmospheric air is admitted to them at the point where the heating effect is required. 6th, That no arrangement of the filling place should be permitted which reduces that part to less than eight feet diameter, from nine to ten feet, according to circumstances, being generally the most advantageous.

The Chairman inquired whether it had been ascertained what was the temperature of the gases when drawn off from the furnace?

Mr. Blackwell replied that it was not accurately known, but it would not be very considerable, as the gases were not ignited. In one mode of carrying out the principle that was adopted in France, the gases were actually passed through water after leaving the furnaces, to separate all impurities and injurious matter, and also to prevent any risk of explosion. In that case, the only heat lost would be the temperature of the gases in coming from the furnace before they were ignited.

Mr. M'Connell noticed that it was stated in the paper that a greater proportion of carbonic oxide was found at one height than at another, and inquired whether any experiments had been made to ascertain the height from which to get the best result?

Mr. Blackwell replied that from twelve to fifteen feet below the top was the greatest depth that he was aware of such a trial having been made. Carbonic acid was generated at the bottom, as the product of combustion, in the neighborhood of the tuyeres; after rising towards the centre of the furnace, the carbonic acid became converted into carbonic oxide, by taking up carbon from the mass of incandescent fuel, and carbonic oxide prevailed there; but higher still the carbonic oxide reduced the iron ore, and much of it became carbonic acid again. At the top of the furnace there was a considerable proportion of carbonic acid, with a portion of

Cases from

BLAST FURNACES.

Pontypool, South Wales.

Fig. 1

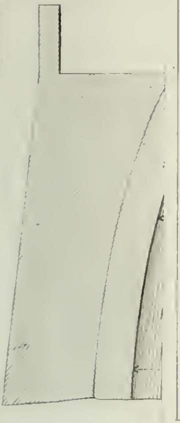
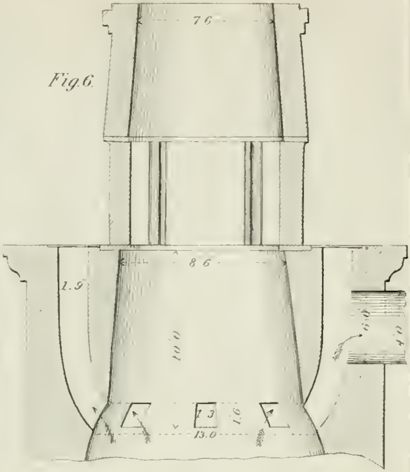


Fig. 6.



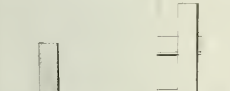
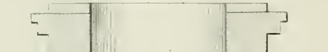


Fig 5



Dundyvan, Scotland.

BLAST FURNACES.

Apparatus for collecting the waste gases.

Fig. 1. *Ebbw Vale, South Wales*

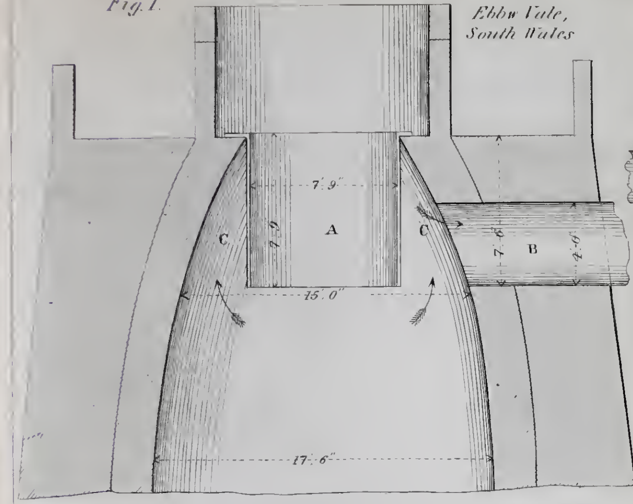
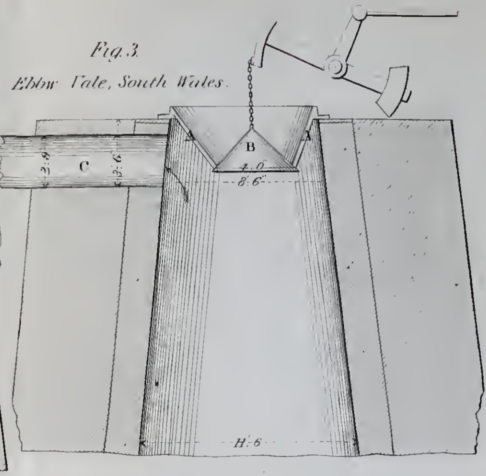


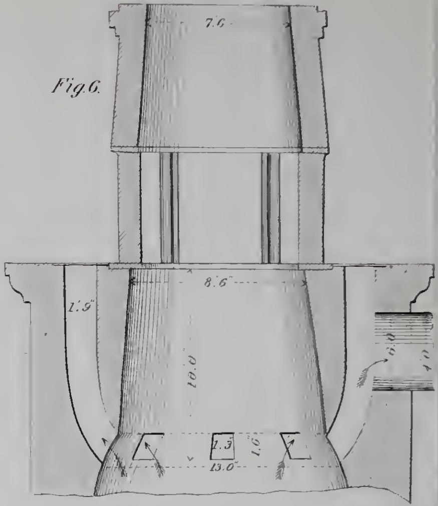
Fig. 3. *Ebbw Vale, South Wales.*



Gases from BLAST FURNACES.

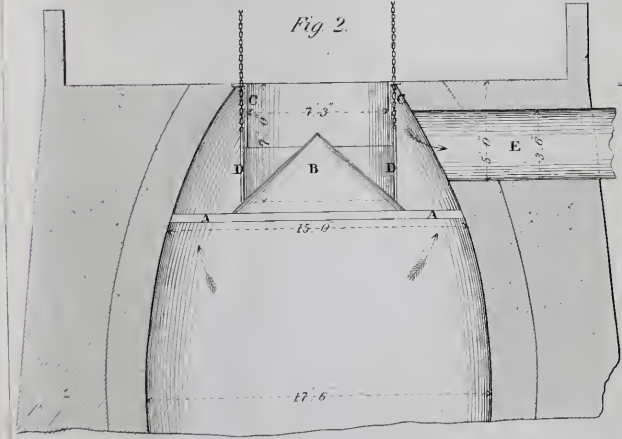
Pontypool, South Wales.

Fig. 6.



Cwm Celyn, South Wales.

Fig. 2.



Bilston New Furnaces, Staffordshire.

Fig. 4.

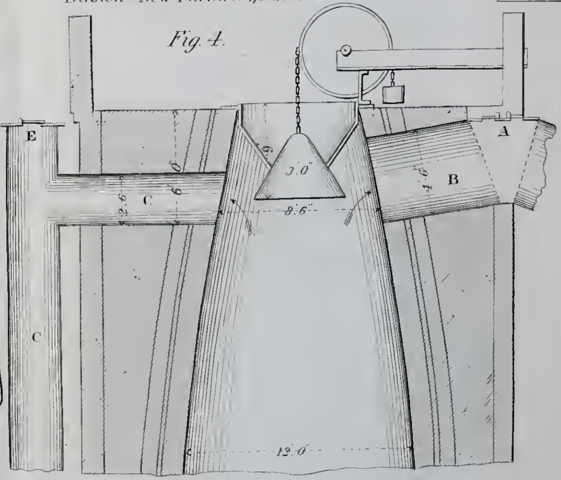
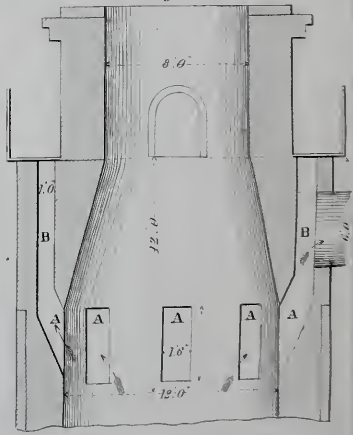
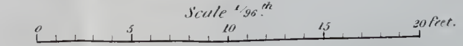


Fig. 5



Dundyvan, Scotland.



carbonic oxide; but in the centre of the furnace there was carbonic oxide alone.

Mr. Slate inquired whether, if only carbonic oxide existed in the centre of the furnace, any experiments had been tried for drawing off the gases from the centre, instead of taking them from the top?

Mr. Blackwell did not know of any experiments having been made for taking the gases from the centre of the furnaces; and he believed that fifteen feet from the top was the lowest that had been tried; but it must be observed that, in all probability, if the gases were drawn off at a lower level it would reduce the yield of the furnace; because the carbonic oxide required to reduce the ore of the metal, and it would take away so much of the reducing power of the furnace.

Mr. Slate remarked that the practical effect would then be to shorten the furnace, and to work with a very short furnace was known to be bad. He suggested that perhaps the reduced make of furnaces with closed tops was due to the reduction of the quantity of air entering the tuyeres, on account of the resistance to the discharge from the top of the furnace being increased, which would tend to diminish the quantity of air blown in by the same blast engine.

Mr. Blackwell did not think that was the case, as it was not always the consequence that the yield was reduced by closing the top of the furnace: at Cwm Celyn a rather greater yield was found with a closed top to the furnace than when open. It must be borne in mind, that from the different composition of the ores in different districts, the plan might succeed in one case, when it would not in another.

Mr. Gibbons remarked that the Staffordshire ore required a double proportion of limestone compared to the Scotch ore, and therefore more carbonic acid was generated in the blast furnace.

In answer to questions from the Chairman, Mr. Blackwell stated, that at the Ebbw Vale Works they were raising the steam for the blast engines entirely by the waste gases from the furnaces, and also heating the blast; and for these purposes, from 15 cwt. to one ton of coal would otherwise be wanted for each ton of iron made. The action was found less destructive to the boilers than the ordinary fire; because the heat was very uniform, and the boiler was not exposed either to fluctuations in temperature or excess of heat.

Mr. Slate observed, that the saving of the consumption of slack in South Staffordshire would amount to only 6d. per ton upon the iron, owing to the small cost of the coal usually burnt under steam boilers.

Mr. Blackwell said, that of course there was a great difference in the value of slack with different qualities of coal. In South Staffordshire, from the slack not having a caking quality, it could be used only for steam boilers and inferior purposes; but in South Wales, most of the refuse slack was a valuable material for making coke, which increased its value very much, and made the saving an important consideration. In reply to a question from Mr. W. Mathews, he said that he had had the plan in operation for three years in some furnaces in Derbyshire; and during that time no instance had occurred of repair being required in the hot air apparatus; but it had to be opened about every six weeks to clear away the deposit of dust. He understood, however, that at the Dundyvan Works a con-

considerable loss of heat appeared to be caused by the thick coating of the pipes with dust.

Mr. W. Mathews remarked, that he had lately been over the Dundyvan Works, in Scotland, where the gases had been applied more extensively than elsewhere, and was informed by the manager that he considered they would be as well without this plan, as they found it had a very prejudicial effect on the heating pipes, though less perceptible on the boilers. In Wales, they appear to be using the plan with considerable advantage, on account of the greater price of fuel and coal slack. In South Staffordshire he thought it doubtful that it would be found advantageous. A very slight interference with the regular working of furnaces would be a serious prejudice both to the quality and yield of iron, and would more than counterbalance any economy arising from the application of the gases.

The Chairman inquired what was the nature of the dust that was found to collect so rapidly on the pipes of the hot blast apparatus?

Mr. Blackwell replied, that the chemical character of the dust was not at present well understood; but that the effects alluded to by Mr. Mathews arose simply from the mechanical action of the very large quantity of minute dust given off from the furnace, which could not be cleaned from the surface of the heating pipes so well as from the surface of the boilers, the draft not being sufficient to prevent it from being deposited on the surface of the pipes.

Mr. M'Connell inquired whether the dust could not be removed by drawing the gases through a screen of wire gauze, so as to filter the air before entering the hot blast apparatus?

Mr. Blackwell replied, that the passage for the air from the furnace should be as free as possible, and the wire gauze would cause too much obstruction. In the French works that had been referred to, the air was carried through water to stop all dust and impurities, which appeared to accomplish the object successfully.

The Chairman asked whether Mr. Blackwell agreed with M. Ebelmen's theory of carbonic acid being first produced, then changed to carbonic oxide, and lastly partly converted to carbonic acid again higher up in the furnace? He could not understand such a process.

Mr. Blackwell said he did not consider himself competent to give any opinion upon the chemical changes occurring in the furnace: he considered the theory a probable one, especially as it appeared to be fully confirmed by M. Ebelmen's experiments, in which the gases were taken off at different heights of the furnace, and subjected to careful analysis.

The Chairman said he could not think that the carbonic oxide took up an atom of oxygen from the oxide of the metal: it was a law of chemical affinity, that the second atom combines with less force than the first. He considered it much more probable that an atom of carbon was taken from the carbonic oxide to unite with the iron; he did not think that the carbonic oxide could deoxidize the iron; and he could not understand the two reverse processes taking place at the same time in the furnace.

Mr. Blackwell said that when in the Exhibition, accompanied by M. Le Play (one of the Jurors of the Exhibition, and Professor of Metallurgy in Paris,) and Professor Faraday, he saw some curious specimens, called 'metallic sponge,' which were formed of pieces of iron ore, exposed when heated, to a current of carbonic oxide, or carburetted hydrogen, which deoxidized them. M. Le Play was acquainted with the process before, but it was new to Professor Faraday, who was much interested with the specimens. He (Mr. Blackwell) had not seen the process of deoxidation, but was informed that it was effected by both means, either by carbonic oxide or by carburetted hydrogen.

In the *London Journal of Arts*, from which the above article is taken, it is unaccompanied by any illustrations; we therefore extract the following drawings and their descriptions, illustrating the various arrangements referred to, from the *Civil Engineer and Architect's Journal*, for January, 1853, received since the publication of the article was commenced:

DESCRIPTION OF PLATE VI.

Fig. 1.—*Ebbw Vale, South Wales.—Page* 189.

A,	Cylinder resting by a broad flanch on the lining of the furnace.
B,	Pipe through which the gases passed off.
CC,	An open space, forming a reservoir for the gas.

Fig. 2.—*Cwm Celyn, South Wales.—Page* 191.

AA,	Two cast iron bearers, (only one of which is visible in the section.)
B,	Cone of cast iron.
C,	Short cylinder, suspended from the filling plate.
D,	A second cylinder, resting on the base of the cone.
E,	Pipe for the passage of the gases.

Fig. 3.—*Ebbw Vale, South Wales.—Page* 191.

A,	An inverted truncated cone.
B,	A cone closing the end of the cone A.
C,	Pipe for the passage of the gases.

Fig. 4.—*Page* 192.

A,	Lid or valve upon the main gas pipe, B.
B,	Main gas pipe.
CC,	Gas pipes.
E,	Covering of gas pipes, CC.

Fig. 5.—*Dundyvan, Scotland.—Page* 245.

AAA,	Flues leading into annular chamber.
BB,	Annular chamber running round the furnace.
C,	Pipe for the passage of the gases.

Fig. 6, shows the arrangement adopted for taking off the gases at a furnace recently erected at Pontypool, and in which it will be seen that the use of the cylinder is abandoned. In reference to this latter point, it is necessary to consider briefly the composition of the gases, and the chemical changes taking place in the furnace.

For the Journal of the Franklin Institute.

On the Analysis of Cast Iron. By Professors Campbell Morfit and James C. Booth.

(Extract from the Official Report to Captain L. A. B. Walbach, U. S. Ordnance, on Foundry Service, upon the Examination of Gun Metal.)

(Continued from page 202.)

Calcium; Magnesium; Sodium; Potassium; Cobalt; Nickel; Iron; Manganese; Aluminum; Copper, and Phosphorus.

Another portion of metal is required to be digested for the estimation of these components, because the filtrate from the carbon, by digestion with iodine does not contain all the phosphorus and alumina, as has already been stated. The filtrate from the digestions in hydrochloric acid for allotropic carbon and for silica and slag have also lost a portion of their phosphorus, which during the digestion passed off as phosphuretted hydrogen gas. Moreover, some of the above constituents are in such small proportions that they cannot be determined in one gramme, the quantity used in the forementioned digestions. The proper course therefore is to proceed as follows:

6th, Five grammes of clippings of metal are placed in a beaker of eight ounces capacity, drenched with fuming nitric acid, covered and set aside in a cool place; for if heated immediately, the reaction would be so violent as to eject particles. After twelve hours, pure nitric acid is added, and the beaker transferred to the extreme end of the sand bath, so that it may not be subjected to a higher heat than 212° Fah., as phosphoric acid will volatilize above that temperature, from solutions containing free acid.

When the solution is perfect, as may be known from the flocculent appearance of the insoluble particles, the cover is removed and the liquor allowed to evaporate gradually to dryness. Hydrochloric acid is added, the cover replaced, and digestion continued until re-solution is effected.

The addition of hydrochloric acid is necessary to insure the entire solution of all the oxide as well as basic salt which are formed by the nitric acid, but are insoluble in it or in water alone; besides, some phosphide of iron, which can only be entirely dissolved in hot aqua regia, may otherwise remain, because of its insolubility in nitric acid alone. Hydrochloric acid alone would not answer; for, as before stated, it would dissipate most of the phosphorus, as phosphuretted hydrogen gas.

By this prolonged treatment, which, if pursued as we have directed, causes no loss of phosphoric acid, the iron, chrome, manganese, aluminum, calcium, magnesium, sodium, potassium, cobalt, nickel, and copper are entirely dissolved and remain in the liquid; while the subsident matter contains part of the carbon, all the silex and slag, together with tin and titanium, as oxides, if the latter are present in the metal. It is requisite that the hydrochloric acid used in the redigestion be strong, otherwise the alumina which loses its acid by evaporation becomes difficultly re-soluble. As dense metallic solutions, particularly when acid, are apt to clog the filter, the liquid is next to be diluted with water, so as to facilitate the filtration, then filtered through fine paper, and well washed with hot water. The filtrate is A, the filter *a*. The latter is set aside for subsequent treatment for tin and titanium.

To the filtrate A, aqua ammonia free from carbonate is added in excess. Alumina, and the oxides of chrome, manganese, and iron, with phosphoric acid, are precipitated, while lime, magnesia, cobalt, nickel, copper, sodium, and potassium remain in solution. The presence of ammonia in excess holds up the copper, cobalt, and nickel, and of ammoniacal salts, as a general rule, also retains the manganese in solution as well as the magnesia; but where the iron with which the manganese is associated is so largely in excess, as in the present instance, the latter is wholly precipitated with the former. Of numerous essays, there are very few in which even traces were left. If the solution is not acid previous to the addition of aqua ammonia, some muriate of ammonia must be added. Immediate filtration should always follow the treatment with aqua ammonia, to avoid the transfer of carbonic acid from the air to the lime, and the consequent precipitation of carbonate of lime. The filter is well washed with hot water, and set aside as *b* for the present.

Calcium.—The filtrate B will have a bluish tinge, if any copper is present, and is to be evaporated to a dense solution, mixed with twice its volume of absolute alcohol, and the lime precipitated by a few drops of sulphuric acid. The sulphate of lime is filtered off, washed with dilute alcohol, ignited, weighed, and the amount of calcium calculated from the sulphate.

The filtrate from the lime is then evaporated very cautiously to dryness, and heated to expel every trace of ammoniacal salt; in case the sulphuric acid should be in excess, it is well to neutralize it with a piece of carbonate of ammonia, to be added after the evaporation and previous to the heating, which must be to slight redness, and continued until the weight of the crucible and contents remains constant. This expresses the weight of the sulphate of potassa, soda, and magnesia, with traces of copper, cobalt, and nickel, if they should be present.

The saline mass is dissolved in water and the solution divided into two equal portions. In the analyses of some silicates, a small insoluble residue is apt to be left in making this solution, and it chiefly consists of manganese and silica, but in the present analysis such residue is not observed.

One portion of the solution is treated with chloride of barium, to precipitate sulphate of baryta from the weight, of which the sulphuric acid, doubled, expresses the whole amount of this acid in the joint weight of the sulphates above determined. The excess of baryta being removed from the solution by sulphuric acid, sulphuretted hydrogen is passed through the solution, whereby sulphide of copper if present is precipitated.

Copper.—The sulphide of copper and sulphate of baryta are filtered off, and the copper determined if necessary by re-solution of the sulphide in nitro-muriatic acid, after removal from the paper, and by precipitation when boiling, by potassa. The solution filtered from the sulphide of copper, is tested for cobalt and nickel by adding ammonia and a few drops of sulphide of ammonium, and then acidulating carefully with hydrochloric acid; a black sulphide remaining indicates cobalt or nickel, and may be further tested; but we have hitherto only found traces of these metals in the present analyses.

Magnesium.—The second portion of the solution of joint sulphates is treated with ammonia and phosphate of soda, whereby the ammonia-phosphate of magnesia is thrown down; it is filtered, washed with ammoniacal water, dried, burned off, and the amount of magnesium calculated from the weight of the phosphate of magnesia, which is to be doubled.

Having determined the magnesia and the total amount of sulphuric acid in the joint sulphates, the relative amounts of potassa and soda may be calculated by indirect analysis or by a simple equation; by calculating the amount of sulphuric acid required by the magnesia, which happens to be just twice its weight, and subtracting this from the total amount of sulphuric acid in the joint sulphates, we have the amount of sulphuric acid, *s*, combined with the alkalies. Further, by subtracting the weight of the sulphate of magnesia from that of the joint sulphates, we have the weight of the alkaline sulphates, from which, if their sulphuric acid be taken, the remainder is the joint weight a of the alkalies. Then $2{\cdot}9136\,a - 2{\cdot}258\,s =$ the weight of potassa. This subtracted from a gives the weight of soda. The metals potassium and sodium are calculated from the weights of their oxides. This method of indirect analysis we have found practicable, when the quantities to be weighed are such as to throw the errors of observation into the hundredth place, and when there is not too great a preponderance of one alkali.

In our first essay, we separated the lime from filtrate B with oxalate of ammonia, filtered it off, evaporated the filtrate in a porcelain capsule, under paper cover to avoid dust, ignited to expel ammoniacal salts and chlorine from magnesia, and towards the end added a little oxide of mercury, to insure the expulsion of the last trace of chlorine that might remain, and again heated to redness, to drive off excess of mercury. The magnesia was thus oxidized and rendered insoluble, while the residual components remained soluble. The capsule and contents having been weighed and the weight of capsule deducted, the remainder was noted as the gross weight of magnesia, alkalies, cobalt, and nickel. The latter three being as chlorides, the proportion of radicals was calculated accordingly.

The presence of cobalt and probably nickel was recognised in this method, by the pink tinge in the evaporated saline mass, but their quantity was too small to determine. The soluble matters were dissolved out by hot water, and the insoluble magnesia separated by filtration, dried, ignited, and weighed; its weight deducted from the gross weight of the magnesia and alkaline chlorides, gave the amount of the latter, whence was calculated their proportion of radicals.

It is very difficult, even with the most skilful manipulation, to prevent a partial volatilization of the alkaline chlorides at the temperature necessarily used in the ignition, especially in a current of air and where a quantity of ammoniacal salt is sublimed, but yet it has hitherto proved the more accurate method.* Since however the quantities of alkali in these analyses proved exceedingly small, we preferred the former process, and determined only the joint amount of potassa and soda.

The contents of filter *b*, consisting of oxides of manganese, chrome and iron, with alumina combined with phosphoric acid, are carefully transferred from it with a porcelain spatula to an eight ounce beaker glass; the filter is washed with hot water, dilute hydrochloric acid, and lastly with hot water, to remove every trace of iron solution that may be retained in the pores of the paper.

This process of solution by displacement of the portions of iron adhering to the filter saves time, trouble, and loss, as it reduces the number of filtrations which would otherwise be necessary if the filter with its contents had been jointly digested.

The filter, containing nothing, is rejected. The filtrate, holding in solution the entire contents of the filter, is to be neutralized with aqua ammonia and then treated with a slight excess of hydrosulphide of ammonium, and immediately afterwards with two fluid drachms of caustic potassa solution of specific gravity 1·30. All the iron as well as manganese precipitates as sulphide; but the alumina and chrome are retained in solution by the potassa. As soon as the precipitate has wholly subsided, but not until then, and it is therefore well to promote the separation by gently warming the liquor upon the ledge of the sand bath, the clear supernatant liquor is filtered off, and six fluid drachms of caustic potassa solution of 1·30 added to the sediment, and the whole digested for a few minutes on the sand bath to insure the removal of every trace of alumina and phosphate. It is then diluted with water, filtered on the same filter as employed for the first liquid, and washed with dilute hydrosulphide of ammonium to prevent the formation of soluble sulphide of iron by the action of air and water. The filtrate is C and the filter *c*.

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* The recent method of Lawrence Smith, (*Am. Jour.*,) is an important improvement in the removal of ammoniacal salt.

The filter *c* contains iron and manganese as sulphides, and its contents must be digested in nitric acid, filtered and washed to separate any unoxidized sulphur. Hydrochloric acid cannot be substituted, for the nitric, as it is absolutely necessary that all the iron shall be in a state of peroxidation, because, if any of it is protoxide, it remains in solution with the manganese and leads to error. If the potassa was not entirely removed from it by hot washing previous to the digestion, it will now exist in the liquor as sulphate and nitrate, and being an impediment to the after steps of the process must be removed. This is done by precipitating the iron and manganese by ammonia, washing with hot water, and redissolving in hydrochloric acid. When the solution has become cold it is ready to be treated for the separation of the manganese from the iron, which is accomplished by adding a slight excess of pure carbonate of baryta portionwise, setting aside for twelve hours at the ordinary temperature, and stirring occasionally during the interval. When the reaction is completed, all the iron has precipitated, while the manganese remains in solution. The whole is to be filtered and washed with hot water. The filtrate is D and the filter *d*. The filtrate D is frequently cloudy, owing to the intimate suspension of particles of carbonate of baryta and iron precipitate which passed through the filter, and these must be separated, to prevent their contaminating the manganese by after solution in acid. The solution is therefore evaporated to one-fourth its volume, and the suspended matters, whose subsidence is thus effected, filtered off and added to the filter *d*. The evaporation answers the double purpose of concentrating the liquor sufficiently to insure the entire separation of the baryta salt, which is then removed by the addition of sulphuric acid, filtering and washing with hot water. The filtrate is further evaporated under paper cover, tested with a drop of sulphuric acid, to be assured of the absence of baryta, and treated with a clear solution of carbonate of soda in slight excess. The whole is well warmed in the sand bath, the precipitated manganese filtered off, washed with hot water, ignited until the weight remains constant, and the amount of metal deduced by calculation. The manganese is precipitated as carbonate, but when highly ignited in contact with air, like all the other oxides of manganese, it becomes manganoso-manganic oxide, (MnO, Mn^2O^3,). To reach this state it requires prolonged treating and consequently the ignitions and weighing must be repeated twice or thrice, as may be necessary, to ascertain when this condition is reached.

Iron.—The contents of filter *d*, consisting of pure oxide of iron with excess of carbonate of baryta, are transferred with a platinum spatula to a beaker glass, and the traces adhering to the filter displaced by hydrochloric acid and hot water, as directed before. After digestion with a little more hydrochloric acid until solution is complete, sufficient sulphuric acid is added to precipitate all the baryta salt as sulphate, which is then filtered off. Before filtration, it is better to allow repose, so that the precipitate may subside and have a clear supernatant liquor. This passes the filter very readily, and when all of it has gone through, the pasty residue should be drenched with hot water, poured upon the filter, and washed with hot water. The filtrate is less apt to be cloudy by this mode. A drop of sulphuric acid is to be added to the filtrate to obtain assurance that there is no baryta retained in the solution. Beakers should be exclusively used as containing vessels in these separations of baryta, for glass shows much more readily than porcelain, whether any suspended particles cloud the filtrates.

As the sulphate of baryta, precipitated from the iron solution, tenaciously holds a portion of the latter, the former must be well washed in the filter, first with hydrochloric acid, and then with hot water.

The consecutive addition of hydrochloric and sulphuric acids to the contents of filter *d*, is much better than the seemingly shorter plan of adding sulphuric acid direct and alone, to the filter, and displacing the iron as soluble sulphate, while the insoluble sulphate of baryta remains upon the paper. The latter mode endangers the carbonization of the filter, and the introduction of soluble organic matter into the liquid, which would in a subsequent stage prevent the entire precipitation of the oxide of iron.

The clear iron solution freed from baryta is to be treated with aqua ammonia in slight excess, and the precipitated oxide of iron filtered off and washed well with hot water; the filter is then thoroughly dried in the air chamber, its contents detached, and the two ignited separately in a platinum crucible, to prevent reduction of oxide by the carbon of the filter. The metallic iron is then calculated from the weight of Fe^2O^3.

Our experience proves that manganese is separated from iron in a satisfactory manner by carbonate of baryta; but certain precautions are necessary to success.

At least twelve hours must be allowed for the precipitation of the iron after the addition of the carbonate of baryta, and to be satisfied that all has gone down, it is better to test a drop of the clear supernatant liquor with sulphide of ammonium.

As sulphate of baryta is very liable to pass through the filter, care must be taken in every such event to promote its deposition by warmth and to separate it by refiltration.

Manganese is generally separated from iron, when there are no other associates, by carefully neutralizing the hydrochloric solution of the two with aqua ammonia, and then adding succinate of ammonia, the first to retain the manganese in solution, while the latter precipitates the iron. But when the iron is largely in excess, it is impossible to prevent the manganese going down wholly, or nearly so, with it; even although the exact point of neutralization by ammonia, a very nice manipulation, is attained previous to adding the succinate. Besides, the wash water, especially if warm, may induce the formation of soluble acid succinate of iron and carry away a portion of it through the filter. In the ignition of the succinate there is also a difficulty in preventing the carbon of the succinic acid reducing a little of the oxide of iron, when the quantity of the succinate of iron is large. This latter objection may however be partially obviated by washing the filter with cold ammonia instead of hot water.

Herschel's method with carbonate of ammonia founded upon the fact that Fe^2O^3, of the neutral per salts of iron is precipitated from the solutions of these salts by boiling, whilst oxide of manganese remains in solution, and Scherer's, with caustic potassa, which is a modification of it, have also the disadvantage of requiring difficult manipulation and very exact pre-neutralization to insure the precipitation of the one and the retention of the other (*Rose* ii. 93).

Henry's process, (*Journ. de Chim. Med.* 1850,) without yielding any more accurate results than the carbonate of baryta plan, is tedious and time consuming; moreover, as organic matter is used the manganese may be partly retained in solution as protoxide, and its correct estimation subsequently prevented.

The filtrate C contains the greater part of the phosphoric acid, in combination with the potassa which was added with the hydrosulphide of ammonium; the remainder, which is a very minute portion, is, with the alumina as a very basic compound, held in solution by the potassa.

In most of the processes heretofore followed by chemists, in the analysis of cast iron, the obstinate affinity of phosphoric acid for alumina has been overlooked, and that portion of it combined with the alumina, owing to the difficulty of separating it, disregarded in the determination of phosphorus.

If any excess of hydrosulphide of ammonium was added, it remains in the filtrate, and the latter must therefore be digested with nitric acid for some hours, below 212° Fah., to expel ammoniacal salt and promote the subsidence of unoxidized sulphur, which after twelve hours repose must be filtered off. It is not advisable to take the shorter method, after adding the acid to separate sulphur, and pour in aqua ammonia to throw down alumina with the sulphur, hoping to expel the latter during ignition; for sulphur first precipitated redissolves under these circumstances; care must also be observed to keep the heat always below 212°, or there will be loss of phosphoric acid by volatilization.

After the sulphur is separated by filtration, the filtrate is to be treated with a slight excess of aqua ammonia, the vessel covered with paper, and heated upon the sand bath; after a time cloudiness ensues, and alumina falls down, and must be filtered off, washed with hot water, and set aside as *e*; the filtrate is E.

Phosphorus.—The filtrate E contains only alkaline phosphates, and after being supersaturated with hydrochloric acid, is then to be treated with a nitric solution of ·5 gramme of fine iron wire, carefully precipitated by aqua ammonia, filtered, the filter washed with hot water, dried and ignited (paper separately), and weighed. The excess of weight over the amount of Fe^2O^3, that ·5 gramme of iron should form by solution in nitric acid, is the amount of phosphoric acid which the quantity of phosphorus in the filtrate makes;—hence the latter may be deduced by calculation.

To separate the remaining traces of phosphoric acid from the aluminous precipitate, the latter must be dissolved in hydrochloric acid, and treated with tartaric acid until the solution ceases to give any precipitate by aqua ammonia. The tartaric acid prevents the precipitation of the phosphate of alumina by the ammonia. When barely supersaturated with aqua ammonia, a solution of sulphate of magnesia is added, containing so much of muriate of ammonia as will prevent the precipitation of the magnesia by the caustic ammonia. The magnesia carries down the phosphoric acid as triple phosphate, from the alumina, the solubility of the latter being promoted by the tartaric acid; after several hours repose it is filtered, washed with ammonia water, dried, ignited, weighed, and the amount of phosphorus calculated. It is added to that obtained from filtrate E.

Aluminum.—The alumina is next determined by evaporating the filtrate to dryness, burning off to charcoal, fusing the balance with bi-sulphate of potassa, to destroy the remaining carbon and render the alumina soluble, redissolving in hydrochloric acid, precipitating by carbonate of ammonia, washing with water, igniting, and weighing.

Where a larger quantity of phosphoric acid and alumina is to be separated, it is a safer plan to redissolve the alumina, and treat it again in the same way with tartaric acid, magnesia, &c.; but we have not found it necessary in the present analysis. The alumina obtained is tested for chrome.

This method has been found to give the most reliable results. The separation of phosphoric acid from iron alone may be readily effected by several methods; but when alumina is an associate of the iron, then the task is very difficult, owing to the similarity of behavior of alumina and its phosphates to reagents, the affinity of phosphoric acid for alumina being very obstinate.

The process at first followed by us with great confidence was that of Berzelius, with some modifications by Rose and ourselves, and we only abandoned it, after numerous and repeated essays had convinced us of its unreliability. The iron, after the separation of the manganese and every other component, except phosphoric acid and alumina, was dissolved in hydrochloric acid, supersaturated with carbonate of soda, evaporated to dryness, transferred to a platinum crucible, mixed intimately with two parts of impalpably fine and pure silex, and six parts of carbonate of soda to every one of phosphate, and the whole highly heated to fusion for half an hour.

The silica is added to detach the phosphoric acid from the alumina, while a part of the carbonate of soda combines with it at the moment of elimination to form phosphate of soda. The remainder of the carbonate of soda unites with the excess of silica. There are two affinities simultaneously exercising their preference, and thus the phosphoric acid as soon as eliminated by the silica, which unites in turn with the alumina it has displaced, is embraced by the carbonate of soda. Carbonate of soda alone would not answer, for though it will by *fluxing* remove phosphoric acid from iron, it does not separate it from alumina.

After fusion, the fluxed mass was emptied from the platinum crucible into a silver capsule, and repeatedly boiled with water, filtered after each boiling, and the several liquors or filtrates united; the filter 1 contained the oxide of iron and alumina, with free and combined silica: the filtrate 2 held in solution the phosphorus as phosphate of soda, the excess of carbonate of soda, and some silicate of soda formed during the fusion.

The content of the filter 1 was digested with hydrochloric acid for solution, then evaporated to dryness to render silica insoluble, redigested in hydrochloric acid, diluted, filtered, and hot washed. The iron and alumina were in the filtrate, and the silica remained upon the filter, and was discarded. It is inadvisable to throw the filter and its contents together into the beaker; for, hot digestion with acid renders a portion of the organic matter of the paper soluble, and thus makes the subsequent precipitation of the iron imperfect. It is much better to remove the iron from the filter with a platinum spatula, and to displace the adhering traces with hydrochloric acid and hot water, as directed in a previous page. The paper filter would then be thrown away, as the washing with acid and water removes every trace of iron and alumina.

The filtered liquor was boiled in a silver capsule with a slight excess of caustic potassa solution, filtered, and washed with hot water. To remove the potassa obstinately retained by the iron on the filter, the latter was redissolved in hydrochloric acid, precipitated by aqua ammonia, filtered, thoroughly washed with hot water, and dried. The paper and contents were ignited separately and weighed.

The filtrate which contained the aluminate of potassa was supersaturated with hydrochloric acid, and then treated with carbonate of ammonia, which threw down alumina as well as the silicic acid that remained in the liquid as soluble silicate. After filtration, the two were separated by digestion in hydrochloric acid, and evaporated to dryness, which left the silica and dissolved the alumina. The latter was then precipitated from the filtered solution by carbonate of ammonia, dried, ignited, and weighed.

Now even at this stage of the process, there is a serious objection; in the first place, during the fusion with carbonate of soda a portion of the iron as well as of the alumina will inevitably unite with some of the silica to form a slag insoluble by subsequent digestion in acid, thus giving rise to an error in the estimation of both these ingredients. Moreover, the boiling with carbonate of soda may have caused the solution of traces of free alumina as well as of phosphate, either of which is partially soluble in a dense solution of carbonate of soda. These being passed into the phosphate filter serve to contaminate it.

The contents of the filter 1 having been estimated, the filtrate 2 containing phosphate and silicate of soda with excess of carbonate of soda, was neutralized with hydrochloric acid to remove carbonate of soda, and then treated with a given weight of fine iron wire dissolved in nitric acid. The phosphoric acid was then precipitated with the iron by caustic ammonia, redigested in hydrochloric acid, and evaporated to dryness to remove any silica that may have fallen with the phosphate and oxide of iron, and the latter was then reprecipitated from the filtered solution with aqua ammonia.

The evaporation to dryness, as above directed, was very necessary, as some silica invariably goes down, but the quantity is in proportion to the density of the solution; the more dilute, the less is the quantity of silica which precipitates. The evaporation of the iron solution with hydrochloric acid endangers the volatilization of the phosphoric acid, and prolongs the process; and we therefore endeavored to provide against these drawbacks, by igniting the mixed precipitates of phosphate and oxide of iron and silica, weighing, redigesting the calx in hydrochloric acid, filtering, washing with hot water, drying, and igniting the insoluble residue, and estimating the oxide of iron and phosphoric acid by loss. But there was almost invariably a fusion of a portion of the iron and silex into insoluble slag, and a serious loss thus occasioned. Rose proposes (*Chem. Gaz.*, viii. 20,) to precipitate the silicic acid from the filtrate containing the soluble matters of the fluxed iron, alumina, &c., directly by carbonate of ammonia. We do not think that this gives a reliable result, for even if the solution were very dense, the precipitated silex would be in a gelatinous state, and consequently soluble in the water used for washing. Therefore, when the filtrate, after neutralization by hydrochloric acid, is treated according to Rose's directions, with sulphate of magnesia to precipitate triple phosphate, a portion of silica goes down with it. This fact was ascertained by digesting the ignited ammonia-phosphate of magnesia in hydrochloric acid, which left in every essay an insoluble residue of silicic acid. It was also observed, that during this digestion a part of the phosphoric acid was volatilized, as free magnesia existed in the solution.

We sought to obviate these difficulties by evaporating the phosphate filtrates to dryness, before neutralizing the excess of carbonate of soda with hydrochloric acid; but we found it impossible to render all the silica insoluble in this way, although it prevented the volatilization of the phosphoric acid. We therefore neutralized the filtrate in its *dilute* state with hydrochloric acid, added a nitric of solution of a given weight of fine iron wire, and proceeded as already mentioned on the preceding page, and with the same unsatisfactory results.

Rose was the first to note that phosphoric acid was volatilized from acid solutions of phosphates by heat, and the confirmation of the fact by ourselves was soon after reaffirmed by some conclusive experiments by Bunce, (*Silliman's Journal*, 1851,) which show the loss to vary from 8 to 50 per cent.

The process which we give in a former page is a slight modification of Otto's, and has the support of our experience in favor of its being the most reliable for these investigations. It differs favorably from others in permitting the entire separation of phosphoric acid from alumina, as well as other associates, and also in requiring fewer digestions with acid, and in prescribing a limitation of the temperature to 212° Fah., and thus of preventing as far as possible any loss of phosphoric acid by volatilization. The only inconvenience attending it is burning off a large amount of tartaric acid, and the separation of the alumina from the excess of magnesia added.

Fuchs has given a method, (Rose, ii. 438,) by which the silica, instead of reacting by fusion, is added to a hydrochloric solution of the oxide of iron, alumina, and phosphoric acid, in the state of liquid silicate of soda. Ulgren (*Jour. Prac. Chem.*, liii. 37,) amended it by substituting a mixture of silicate of soda and sulphide of potassium, so that the iron may be precipitated as sulphide, the alumina as silicate, and the phosphoric acid remains in solution with the alkali. This is a very ingenious process, but is no less tedious than Rose's, and is moreover equally objectionable in other respects, from a liability of loss of phosphoric acid and alumina, owing to the repeated digestions required to isolate them from silica, &c. There is also a more recent method of the same chemist, (*Chem. Gaz.*, 1851,) based upon the permanent solubility of the ammonia-phosphate of magnesia in small quantities of ammoniacal solution of tartrate of iron, but not in ferridcyanide of potassium—tartaric acid and cyanide of potassium being the reagents employed. It may yield correct results, but it has no advantage over Otto's plan as to time and easiness of execution.

Reynoso's method of separating phosphoric acid by oxide of tin, (*Chem. Gaz.*, ix. 418,) appearing only to have been tried with an alkaline phosphate, we have not thought it necessary to devote the time required to determine its applicability to an aluminous compound, since we found Otto's plan all-sufficient for our purpose.

(To be continued.)

For the Journal of the Franklin Institute.

The Cunard Steamer Arabia.

The following communication has been called forth by the article in the Feb. number of the *Journal*, quoted from the *Artizan*. The greatest discrepancy between the two accounts is doubtless owing to the fact, that the breadth of beam given by the English Journal was measured on deck; while the other is taken at the load water line.

As some of the dimensions given in the last number of the *Journal*, as those of the *Arabia*, of the British and North American Royal Mail Steamship Co., are calculated to deceive your readers, I furnish you with the following, which are reliable:

Length of keel and fore rake,	285 feet.
Length on deck,	284 " 5 in.
Breadth of beam,	40 " 8 "
Depth of hold,	27 " 8 "
Length of engine space,	82 " 9 "
Tonnage—Hull,	2292·42
Engine space,	706·58
Cylinders, 104 inches in diameter, with a stroke of piston of about	9 ft. 6 or 8 in.
Draft of water at load line,	21 feet.

Boilers—Four return tubular, (836 brass tubes, 8 feet long, in each,) having 16 furnaces.

Water wheels, 36 feet 10 inches in diameter, 28 arms, blades 9 feet 6 inches in length by 3 feet 6 inches in width.

Launching draft,	10 feet 5 in.
With machinery in,	15 "

By this statement of our correspondent, it appears that the proportion of breadth and length in the *Arabia*, is as 1 to 7; and the cylinder capacity is to that of the *Arctic*, or *Baltic*, as 80712 to 70880; tonnage (by United States measurement) 2268 to 2878, so that for the same *tonnage* the proportion of cylinder is 1·44 times greater in the *Cunard* steamer.

As our present law is of such a tenor that the registered tonnage affords no indication of the real capacity of a vessel, it is necessary in comparing the Collins steamers with the *Arabia*, to remember that the depth of the former is 32 feet, while that of the *Arabia* is 27 feet 8 inches; so that the disproportion is even greater than above stated.

Steamboats in the Western Waters.

The following article from an esteemed correspondent will be read with attention. We are not aware that any previous attempts have been made to obtain correct indications of the power developed in the high pressure engines running on the Mississippi. The cards given by Mr. Gilman will therefore be interesting for their novelty, as well as from the high pressure of steam indicated.

One circumstance will be remarked as peculiar. We allude to the small variation existing between the pressure of steam in the boilers and cylinder, which two pressures are, in some of the cards, identical. In low pressure engines the application of an indicator has always shown a difference between these two, of from 1 to 3 pounds per square inch, with wide throttles, and with the shortest steam pipes; a difference exists even between the pressure in the cylinder and in the valve chest, when the piston is in motion; as it is obvious that there must always be *some* variation, (to produce any tendency to motion) and that such variation should be greater, the longer or smaller the pipe, and the greater the velocity of the piston, we think Mr. Gilman should state, for the satisfaction of his readers, where the steam gauge was attached,—what description of gauge was used, and whether it has been verified by the indicator. We make this remark, because the importance of the subject demands great care and accuracy in conducting experiments bearing upon it. Of the numerous cards sent, we publish those specified by Mr. G., as giving average indications of the performance of the engine under different pressures, &c. Among those not so specified, are several in which the exhaust curve passes below the horizontal line struck by the indicator pencil, which is usually called the atmospheric line, and is so called in the engravings; of these No. 7 is the most marked specimen. Can any of our correspondents explain the anomaly of a vacuum indication by a high pressure engine exhausting through a heater into the atmosphere?

COM. PUB.

For the Journal of the Franklin Institute.

To the Committee on Publications.

GENTLEMEN:—The delay in procuring an instrument with a range of pressure sufficiently high for a Mississippi steamer, has prevented me until now from sending you any indicator diagrams, in support of the assertions which I made in the September No. of the *Journal*. The instrument by which the accompanying diagrams were taken, was made by Stillman, Allen & Co.; the steam gauges, of which there were two, by which the boiler pressure was noted, were Borden's, of New Orleans; and readjusted for the occasion by the manufacturers.

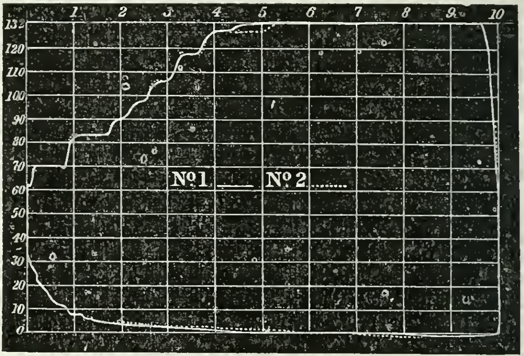
The *Magnolia* is one of the best class of steam boats on the western rivers, and the only one described in "McAlpine's report," which is now running on the lower Mississippi, and to which I have access; but as several of the engines in the boats referred to by Mr. Merrick, were constructed by the same engineer that constructed the *Magnolia's*, it may, in the absence of contrary evidence, be presumed that their proportions are equally as good. The engines of the *Magnolia* were built in 1845, and have been in constant use since that time, with the exception of a short period while changing them from the old to the new boat; the dimensions of the valves, steam ports and pipes, have not been changed since the engines were built; the valves are "double poppet," but not balanced; the main valve having a circular orifice in its centre, three inches in diameter, to which is fitted another valve, which rises three-eighths of an inch before the main valve commences to open; the upper and smaller valve, opening first, fills the port and clearance space, and thus equalizes the pressure on both sides of the main valve before it commences to open; the effect in the labor of the valve gearing is quite as favorable as that produced by the "balance poppet valve," the area of the small valve being about equal to the difference between the two that compose the "balance poppet;" and the effect upon the movement of the steam is sufficiently indicated by the diagrams; the valves are worked by cams, which give them their entire movement during one-eighth of a revolution of the main shaft; the cams being of such a shape as to preclude the possibility of their filling their yokes in all parts of their revolutions, the yoke sometimes is carried ahead of the cam by the weight of the valve lever, and thus produces the slight variation in the point of cutting off observable in the diagrams.

The engines are entirely disconnected; to which feature, with the great length of connecting rod and light construction of the boat, rendering it as supple as a long plank, may be attributed the irregularity of the expansion line, which, it will be observed, increases with the pressure of steam. Each engine has a separate steam and escape pipe and heater; the heaters consist of a cylinder, fitted with plates, lying in a plane horizontal in its diameter, and from three to five inches apart; and filling the cylinder in their width; but each alternate end detached from the cylinder by a space equal in area to the escape pipe, and slightly increased downwards. The cold water is thrown on to the top, and has to pass the entire length of each successively; while the exhaust steam, entering at the bottom, passes between and is brought into contact with each side of every plate successively, besides having to pass through as many sheets of water as there are plates in the cylinders; in general practice, this heater condenses nearly all of the steam, and supplies the boilers with water of the highest possible temperature; and with steam below the maximum pressure, exhaust the cylinder below the atmospheric line, as the diagrams attest.

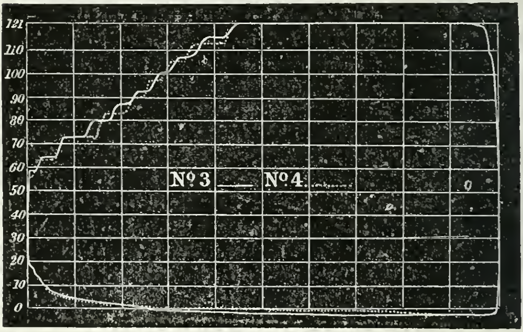
The fuel used in the *Magnolia* is, when running up stream, and in the cotton trade, yellow pine; and down stream, cotton wood, ash, and cyprus; when running down, in the Louisville and New Orleans produce trade, Pittsburg coal is used, with the yellow pine wood as bituminous coal; the boilers furnish an abundance of steam, at a pressure of 140 lbs. per square inch above the atmosphere; with a "wide throttle," and consuming seventy cords of pine wood every 24 hours; coal being sold here by measure, I have no means of knowing how much is consumed per day;

but allowing 40 lbs. per square feet of grate bar per hour, which is the maximum with a natural draft, 98·40 being the area of grate surface, 98·40 × 40 = 3936 lbs. of coal per hour. The other descriptions of wood mentioned, furnished steam with a "wide throttle," of a pressure above the atmosphere of 120 lbs. and a consumption of eighty cords per 24 hours.

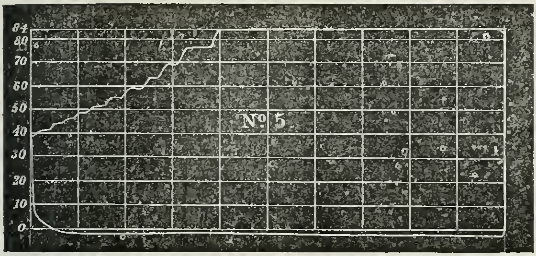
Indicator Diagrams.—Starboard engine, February 2d, 1853.



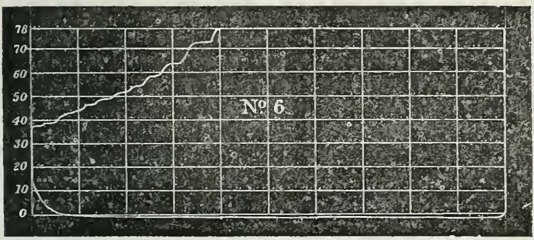
	No. 1.	No. 2.
Revolutions per minute, . . .	13·5	13·5
Portion of stroke during which steam was admitted,	·6	·6
Mean effective pressure on piston. . . .	112·28	111·98
Horses power developed by one engine, .	615·48	613·80
Pressure of steam in boiler, . . .	132 lbs.	132 lbs.



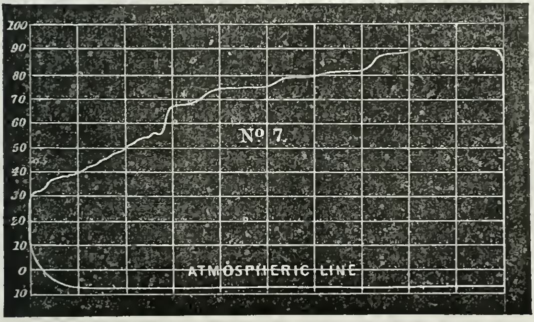
No. 3. Boiler pressure 121 lbs. Full throttle.
" 4. " " 120 lbs. " "



No. 5. Boiler pressure 84 lbs. Full throttle.



No. 6. Boiler pressure 78 lbs. Full throttle.



No. 7. Boiler pressure 120 lbs. Throttle open ½-inch; revolutions (not given.)

These diagrams were taken during an "up trip," and with yellow pine for fuel; Nos. 1 and 2, are the average of about 100, taken during 400 miles travel; Nos. 3, 4, 5, 6, were taken when about to stop, and the boiler pressure reduced; the others were taken to show the effect of throttling. Taking Nos. 1 and 2 for the mean efficiency of the boilers, the following will be the economical efficiency of the fuel. The cubic contents of both cylinders, clearances, and ports, up to the point of cutting off for one revolution, are $(127\cdot428 \times 13\cdot5 \times 60) = 103216\cdot68$ cubic feet of steam per hour of a pressure of 132 lbs. per square inch above the atmosphere; the corresponding volume being 211; therefore $103216\cdot68 \div 211 \times 62\cdot5 = 30570\cdot68$ lbs. of water evaporated per hour by $\left(\frac{70}{24}\right) = 2\cdot916$ cords of wood; $\frac{30570\cdot68}{2\cdot916} = 10483\cdot77$ lbs. of water evaporated by one cord of wood; allowing the wood to be of the best description of yellow pine, weighing 2700 lbs. per cord; then $\frac{10483\cdot77}{2700} = 3\cdot88$ lbs. of water evaporated by one lb. of wood; and if the relative value of the best yellow pine and coal, is as two to one by weight, $3\cdot88 \times 2 = 7\cdot76$ lbs. of water are evaporated by one lb. of coal, in the *Magnolia's* boilers; which is corroborated in another manner; 40 lbs. being the maximum consumed on one square foot of grate bar per hour, $\frac{30570\cdot687}{98\cdot40 \times 40} = 7\cdot76$ lbs. of water evaporated by one lb. of coal; this is exclusive of the steam used by the pumping engine, and the loss by blowing off; it is customary to blow off about once an hour, the quantity being determined by the appearance of the water. I observed the time during which the "mud valve" was kept open, average 20 seconds, with the valve open exceeding the area of the pipe, which is 3 inches diameter, and 21 feet long; the pressure being equal to a column of water $(132 \times 2\cdot30) = 303\cdot6$ feet high; if the periods of blowing off equalled 20 seconds, once in every two hours, the loss would be $\left(\sqrt{}2500 \times 303\cdot6 \div 21 \times \frac{13\cdot88}{3}\right) = 281$ feet per second in velocity; and $\left(\frac{281 \times 20 \times 84 \times \cdot036}{2}\right) = 8497$ lbs. of water of a temperature of 361° blown off per hour; (84 is the contents in inches of one foot of pipe, and ·036 lbs. the contents of 1 inch,) of which 212° were furnished by the feed, and $(361° - 212°) = 149°$ by the fuel. The initial cylinder pressure as shown by the diagrams, is 132 lbs. per square inch above the atmosphere, the total heat of which is 1212°, of which 212° are furnished by the feed; leaving 1000° to be furnished by the fuel. The proportion of water blown off to that evaporated, is 8497 to 30570·68, or five parts blown out and eighteen parts evaporated; therefore,

$$\begin{array}{r} 1000 \times 18 = 18000 \\ 149 \times 5 = 745 \\ \hline 18745° \end{array}$$

= total heat supplied by fuel; 745° being 3·973 per cent. and lost by blowing off, there remains 96·028 per cent. of the fuel utilized; therefore the amount of water evaporated per hour is $\left(\frac{30570\cdot68\times100}{96\cdot028}=\right)$31835·17 lbs.; and by one lb. of coal $\left(\frac{31835\cdot17}{98\cdot40\times40}=\right)$8·08 lbs. of water, exclusive of the amount used by the pumping engine, which could not readily be determined.

DIMENSIONS AND PROPORTIONS.

Length from stem to stern,	295 feet.
Breadth of beam,	35 "
Breadth of floor,	28 "
Breadth outside of guards,	72 "
Depth of hold,	9 "
Draft when light,	4 "
Tonnage, carpenter's measurement,	914·4
Capacity in bales of cotton,	4500
Capacity in pound freight,	1000 tons.
Diameter of wheel when light,	40 feet.
Length of bucket,	12 " 6 in.
Width of bucket,	24 "
Revolutions per minute up stream,	13·5
Diameter of cylinders,	30 in.
Length of stroke,	10 feet.
Length of connecting rod,	35 "
Point of cutting off from the commencement of stroke,	·6
Diameter of main steam valve,	8½ in.
" " upper steam valve,	3 "
" " exhaust valve,	10 "
" " each steam pipe,	8½ "
" " exhaust pipe,	12 "
Number of boilers,	6
Length of each boiler,	30 feet.
Diameter of each boiler,	42 in.
" " flue,	16 "
Superficial area of grate bar,	98·40
Diameter of each chimney,	5 feet.
Height of each chimney above grate bar,	80 "
Area over each bridge wall in square feet,	42·776
Area of the cross section of all flues in square feet,	16·75
" " " the two chimneys,	39·27
" heating surface of all the boilers,	2617·80
Proportion of grate bar to heating surface,	1 to 26·40
" " " area and bridge wall,	1 " 0·4753
" " " " of cross section of all flues,	1 " 0·1702
" " " " " " chimneys,	1 " 0·3986
Coal consumed per horse power per hour,	3·20 lbs.
Water evaporated by 1 foot of heating surface of boilers per hour,	11·29 "
" " " " grate bar per hour,	310.67 "
Horse power developed,	1229

SAMUEL H. GILMAN.

Baton Rouge, La., Feb. 24th, 1853.

For the Journal of the Franklin Institute.

The U. S. Steamship Saranac. By B. F. ISHERWOOD, Chief Eng., U. S. N.

The *Saranac* is one of the four steamships belonging to the United States Navy, commenced in 1847. The hull was built at Portsmouth, New Hampshire; the machinery at Boston, by Coney & Co., from the plans of Charles W. Copeland, Esq. She left Portsmouth, N. H., on the 10th April, 1850, and made her first trip to Norfolk, Va. From that time I am in possession of the logs of all her steaming up to March 29, 1852.

The hull of the *Saranac* is of the same size, and is built of live oak from precisely the same lines, as the *San Jacinto*, a screw propeller steamer belonging to the U. S. Navy, and constructed at the same time as the *San Jacinto*.

HULL.—

Length of keel,	203 feet.
Length on load line,	210 "
Length between perpendiculars,	215 "
Length, extreme,	237 "
Beam, moulded,	37 "
Beam, extreme,	38 "
Depth of hold,	23 " 6 ins.
Depth of keel and false keel,	1 " 3 "
Displacement of sea water,	1838 tons and 1658 lbs. at 15 ft. 3 in. draft of water.
" "	1900 " 15 " 8 " "
" "	2100 " 16 " 9 " "
" "	2202 " and 2055 lbs. at 17 " 3 " "
Immersed amidship section at 15 ft. 3 in. draft of water,	420·05 sq. feet.
" " 15 " 8 " "	438·56 "
" " 16 " 9 " "	477·05 "
" " 17 " "	486·55 "

The *Saranac* is barque-rigged, and spreads 12,800 square feet of canvass in the plain sails.

ENGINES.—Two inclined, direct acting, condensing engines, with inclined forcing air pumps. The cylinder valves are of the double poppet kind; the steam is cut off with the steam valves by Stevens' arrangement.

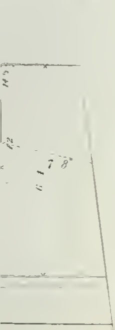
Diameter of cylinders,	60 in.
Stroke of pistons,	9 feet.
Space displacement of both pistons per stroke,	353·43 cub. feet.
Steam space between cut-off valves and pistons at one end of both cylinders,	16 "
Diameter of the disks of the steam and exhaust valves,	12¼ and 13¼ in's.

PADDLE WHEELS.—Of the common radial kind.

Diameter from outside to outside of paddles,	27 feet 6 inches.
Length of paddle,	9 "
Width of paddle,	30 "
Number of paddles in one wheel,	22.
" " in water in one wheel at 16 feet draft,	5.
Area of two paddles,	45 square feet.
Area of all immersed paddle surface at 16 feet draft,	225 "

BOILERS.—Three copper boilers, with double return drop flues. The boilers are placed side by side, with one smoke chimney in common.

Length of each boiler,	27 feet.
Breadth of the centre boiler,	10 " 3 inches.
Breadth of each side boiler,	9 "
Height of each boiler, exclusive of steam chimney,	10 " 3 "
Area of the total heating surface in the three boilers,	5127 square feet.
" " grate " "	191⅔ "
Aggregate cross area of the upper row of flues in the three boilers,	41·528 "
" " middle " "	23·758 "
" " two lower " "	30·295 "
Cross area of the smoke chimney,	31·919 "
Height of smoke chimney above the grates,	62 feet.
Capacity of steam room in the three boilers,	1750 cubic feet.
Weight of sea water contained in the three boilers,	83,600 pounds.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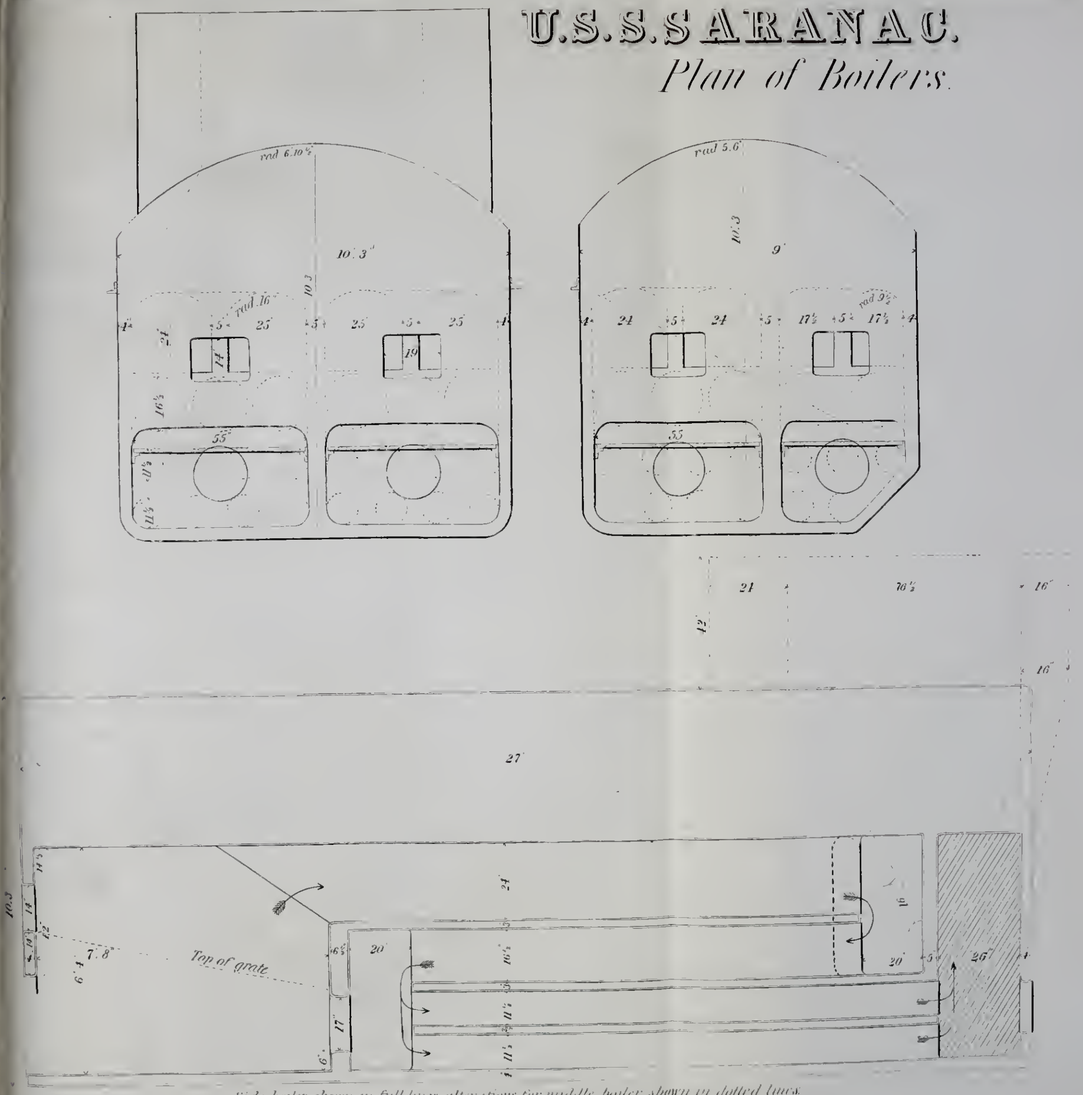
U.S.S. SARANAC.

Plan of Boilers.



Side boiler shown in full lines alterations for middle boiler shown in dotted lines.

PROPORTIONS.

Proportion of heating to grate surface, . .	26·749 to 1·000
" grate surface to aggregate cross area of upper row of flues,	4·615 "
" " " to aggregate cross area of upper row of flues,	8·067 "
" " " to aggregate cross area of the two lower rows of flues,	6·327 "
" " " to cross area of smoke chimney,	6·005 "
Heating surface per cubic foot of space displacement of piston per stroke, ...	14·506 square feet.
Grate surface per cubic foot of space displacement of piston per stroke, ...	0·5423 "

Steam Log.—The steam log has been divided into two tables, the one iving the performance under steam and sail, the wind being chiefly abaft he beam; the other giving the performance under steam alone, the wind eing chiefly forward the beam. The double stroke of piston, steam presure, and point of cutting off may be depended on with absolute certainty, s the first was taken by counter, and the second, which rarely varied but per centum in an hour, was determined from the mean of observations very fifteen minutes; the last was determined by the indicator. The two lements in the performance on which doubt may reasonably be supposed o exist are, the speed of the vessel, which was determined by the *chip og*, and the consumption of fuel, which was ascertained by measure, the verage weight of a fixed measure being taken as the standard.

In the ordinary operation of a steamer, it cannot be known whether the mount of fuel logged opposite an hour, was actually burned in that hour, s the log only expresses the quantity of fuel actually put in the furnaces luring that hour. As the means given in the tables, however, are usually or many hours, this source of error must, for the aggregate, be greatly reluced. And when the large number of observations are considered, vhich go to make up by their mean the final result, it is probable that esult is a very close approximation to the truth.

In the steaming given in both tables under dates of April and May, 1850, it is certain the speed of the vessel was overlogged, as is manifest y a consideration of the slip, which was only between 4 and 5 per centum vhen steaming against a moderate breeze. In this case, the revolutions eing by counter, the error must have been made in logging the vessel, s the slip could not have been less than about 16 per centum.

The evaporation in the *table of results*, is calculated from the number f cylinder charges of steam, and from Regnault's data for the total heat f steam of the different pressures. The agreement in the two cases is ery close.

TABLE OF THE PERFORMANCE OF THE "SARANAC" UNDER STEAM ASSISTED BY SAIL.

DATE.	Number of consecutive hours.	Speed of the vessel per hour, in knots of 6082⅔ feet.	Course of the Vessel.	WIND.		Sail.	Sea.	Mean draft of vessel.		Immersion of lower edge of paddles.		Slip of the centre of pressure of the paddles in per cents. of its speed.	ENGINES.					Cumberland bituminous coal consumed per h'r.
				Direction.	Kind.								Steam pressure in boiler per square inch above atmos.	Double strokes of piston per minute.	Steam cut off at from commencement of stroke.	Proportion of throttle open.	Back pressure in condenser per gauge.	
								ft.	in.	ft.	in.		lbs.		ins.		lbs.	lbs.
Ap. 10, 11, 12, '50	10	10·487	——	On quarter.	Mod. breeze.	All sail.	Smooth.	15	10	4	5	4·64	7·0	13·713	48	3-16	1½	1783
May 21.	24	11·500	S ¾ W.	E. S. E. or abeam.	" "	Jib, foretopsail and spanker	"	16	0	4	7	6·58	11·4	15·350	42	7-16	1½	2725
May 24.	19	10·580	S. W.	S. E. or abeam.	Mod. wind.	Topgallant.	"	15	9	4	4	12·95	9·7	15·160	42	¼	2	2720
June 4 and 5.	7	9·000	S. by W¼W.	E. S. E. or abeam.	Strong wind.	Fore topmast staysail, main trysail and spanker.	Ordinary.	16	2	4	9	4·89	8·3	11·800	42	3-16	2	1605
June 9 and 10.	42	8·883	N.	South or aft.	Mod. wind.	Topsails.	Smooth.	15	7	4	2	12·95	8·0	12·724	42	3-16	1½	2094
Jan. 27, 28, '51.	33	8·633	S. by E.	S. W. or for'd the beam.	" "	Fore and aft.	"	17	9	6	4	14·18	12·5	12·544	42	¼	1½	2140
Jan. 29,	14	7 500	S. by E.	" " "	Strong wind.	" "	Chopping sea.	17	7	6	2	17·96	13·5	11·400	42	½	1½	1843
March 6, 7, 8.	52	9·210	N. W.	E. or on quarter.	Mod. wind.	All sail.	Moderate sea.	15	9	4	4	3·83	9·9	11·942	54	⅝	2	1971
March 16, 17.	10	8 800	W. N. W.	" " "	" "	Topgallant.	Smooth.	15	9	4	4	12·88	10·0	12·596	60	⅛	2	2550
April 3.	12	9·500	N. W.	N. or for'ard the beam.	" "	" "	"	15	9	4	4	24·79	14·2	16·750	54	½	2	3760
June 6.	24	8·830	N. W. ¾ N.	" " "	Gentle br'ze.	Topsails.	"	16	9	5	4	9·00	12·0	12·220	42	¼	2	2950
July 4.	24	9·292	N. N. E.	W. or abaft the beam.	Strong wind.	All sail.	"	15	6	4	1	12·88	14·0	13·300	54	¼	2	3067
July 6.	20	9·100	N.	S. E. or on quarter.	Mod. wind.	" "	"	15	2	3	9	15·95	14·0	13·500	54	½	2	3200
August 29.	24	8·833	S. by W.	E. by N. or ab'ft the bm.	Strong bree.	Topgallants.	Heavy ahead.	17	2	5	9	10·45	13·0	12·300	54	⅜	2	2817
Oct. 7 and 8.	48	8·583	N. W.	N E. or abeam.	Strong wind.	Topsails.	Heavy sea.	17	3	5	10	15·78	12·5	12·700	54	7-16	2	2523
December 26.	24	7·792	S.	S. E. or for'rd the beam.	Mod. wind.	" "	Smooth.	17	2	5	9	14·01	10·5	11·300	54	⅜	1½	1846
December 31.	24	8 417	S.	E. or abeam.	" "	All sail.	"	16	7	5	2	21·08	13·4	13·300	54	½	1½	2625
March 11, '52.	24	7·917	E.	W. or aft.	Strong wind	Studding sails set.	Moderate sea.	17	6	6	1	14·15	9·0	11·500	54	¼	2	2217
March 14,	12	8·000	S. W.	N E. or aft.	" "	" "	" "	17	1	5	8	0·24	9·0	10·400	54	¼	2	2216
March 19, 20.	24	8 583	N. W.	S W. or aft.	Mod. wind	" "	" "	16	6	5	1	17·67	10·5	13·000	54	⅙	1½	3034
Mar. 27, 28, 29.	48	9·146	W.	E. or aft.	" "	All sail set.	Smooth.	15	9	4	4	15·52	9·1	13·500	54	¼	2	3260
Means.		8·985						16	5	5	0	12·61	10·9	12·822	50	·36	1·9	2525

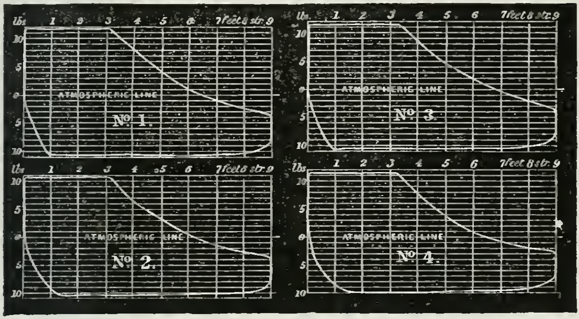
TABLE OF THE PERFORMANCE OF THE "SARANAC" UNDER STEAM ALONE UNASSISTED BY SAIL.

				WIND.								ENGINES.					
DATE.	Number of hours.	Speed of the vessel per hour, in knots of 6082⅔ feet.	Course of the vessel.	Direction.	Kind.	Sea.	Mean draft of vessel.		Immersion of lower edge of paddles.		Slip of the centre of pressure of the paddles in per cents. of its speed.	Steam pressure in boilers per square inch above atmos.	Double strokes of piston per minute.	Steam cut off at from commencement of stroke.	Proportion of throttle open.	Back pressure in condenser per gauge.	Cumberland bituminous coal consumed per h'r.
							ft.	in.	ft.	in.		lbs.		ins.		lbs.	lbs.
April 10, 11, and 12, 1850.	40	11·027	S. by W.	On bow.	Mod. breeze.	Smooth.	15	10	4	5	4·66	6·9	13·115	48	1/4	1½	1922
May 19 and 20,	29	11·531	N.	S. and E. or on bow.	"	"	16	2	4	9	4·14	11·3	15·000	42	3/8	1½	2572
June 5, 6, 7, and 8.	65	6·049	N. E.	N. E. or on bow.	Strong wind.	Rough.	15	11	4	6	23·73	9·8	9·890	42	1/4	2	1917
October 15, 16, and 17.	31	9· 29	S. S. W.	N. E. or ahead.	Light breeze.	Smooth.	15	4	3	11	22·26	13·2	14·644	42	1/4	2	3147
December 4 and 5.	25	7·644	S.	S. or ahead.	"	"	17	3	5	10	10·60	11·6	10·662	42	·6	2	1880
January 27, 1851.	15	7·793	S.	S. or ahead.	Mod. wind.	"	17	9	6	4	9·45	11·1	16·734	42	1/4	1½	1892
Jan. 29, 30, 31, and Feb. 1.	74	7·486	E.	S. E. or on quarter.	Strong wind.	Rolling and chopping sea.	17	5	6	0	17·14	12·6	11·265	42	·3	1½	2146
Feb. 12, 13, 14, and 15.	84	6·740	N. W.	E. or ahead.	"	Heavy head sea.	15	10	4	5	29·42	8·5	11·033	54	·6	1½	2450
March 15 and 16.	20	8·750	"	N. W. or ahead.	Mod. wind.	Smooth.	15	8	4	3	13·14	10·0	12·562	60	5/8	1½	2410
March 17, 18, and 19.	46	8·626	N. N. W.	" "	Strong wind.	Moderate.	15	5	4	0	22·46	12·7	13·872	60	·3	1½	3772
April 4 and 5.	44	9·25	S. E.	W. or for'ard the beam.	Light breeze.	Smooth.	15	7	4	2	26·41	12·0	15·678	60	1/4	1½	4386
May 18, 19, 20, and 21.	70	6·141	N. W.	S. and E. or ahead.	Strong wind.	Rough.	17	5	6	0	30·67	13·5	11·051	42	·4	1½	2428
June 7 and 8.	44	7·955	S. E ½ S.	N. or forward the beam.	Mod. wind.	Moderate.	16	6	5	1	27·23	13·0	13·631	42	·4	1½	3294
June 29 and 30.	48	6·585	E.	S. and E. or ahead.	Strong wind.	"	17	3	5	10	22·93	12·8	10·655	42	1/2	1½	2515
July 1 and 2.	48	7·319	N.	E. or ahead.	Fresh breeze.	"	15	10	4	5	22·90	14·3	11·850	54	1/2	1½	2856
July 3.	24	8·83	N. N. E.	E. by S. or abaft the bm.	Light breeze.	Smooth.	15	8	4	3	22·97	13·9	13·900	54	·4	1½	3075
July 5.	24	7·875	S.	N. E. or ahead.	"	"	15	4	3	11	23·88	14·0	12·900	54	3/8	1½	3054
August 30 and 31.	48	7·208	S. W.	S. or ahead.	Strong bree.	Heavy head sea.	16	11	5	6	19·39	13·5	11·156	54	1/2	1½	2446
September 1, 2, and 3.	68	8·471	N. W.	S. W. or ahead.	Light breeze.	Smooth.	16	8	5	3	21·50	13·5	13·466	54	1/2	1½	2859
October 6.	12	8·167	S. by E.	N. E. or abeam.	"	"	16	11	5	6	24·00	14·0	13·400	54	1/2	1½	2325
December 25.	24	7·000	S. E.	S. E. or for'rd the beam.	Mod. breeze.	Moderate.	16	10	5	5	20·65	9·8	11·000	54	5/8	2	2030
December 28, 29, and 30.	72	7·431		E. or forward the beam.	Light breeze.	Smooth.	16	4	4	11	11·47	12·3	10·467	54	1/2	2	2143
January 24, 1852.	24	6·750	E.	E. or ahead.	Fresh wind.	Heavy head sea.	17	2	5	9	19·84	11·0	10·500	54	1/2	2	1763
Jan. 30, 31, and Feb. 1.	72	4·986	N. E.	N. E. or ahead.	Strong wind.	"	16	9	5	4	36·77	11·6	9·833	54	·6	2	2246
February 2 and 3.	48	5·938	"	" " "	Mod. wind.	Moderate.	16	6	5	1	36·17	10·8	11·600	54	1/2	2	2448
February 4 and 5.	48	6·313	"	" " "	Light breeze.	Smooth.	16	3	4	10	29·71	7·8	11·200	54	·5	2	2100
Means,		7·405					16	5	5	0	21·84	11·6	11·814	50	·41	1·7	2540

TABLE OF THE RESULTS FROM THE LOG OF THE "SARANAC."

	Mean performance under steam assisted by sail.	Mean performance under steam alone unassisted by sail.	Mean of the total performance under steam assisted by sail, and under steam alone unassisted by sail.
OBSERVED.			
Total number of hours, ...	528	1·147	1675
Speed of the vessel per hour in knots of 6082⅔ ft.,	8·985	7·405	7·903
Mean draft of vessel in feet and inches, . .	16 5	16 5	16 5
Immersion of lower edge of paddle in feet, .	5·	5·	5.
Steam pressure in boilers, in pounds per square inch above the atmosphere, . . .	10·9	11·6	11.4
Steam pressure by indicator in cylinders, in pounds per square inch above the atmosphere, .	7·9	9·1	8·7
Double strokes of piston made per minute, .	12·822	11.814	12·132
Steam cut off at, from commencement of stroke of piston, in inches,	50·	50.	50·
Proportion of throttle open, ...	·36	·41	·39
Back pressure in condensers, in pounds per square inch, ...	1·9	1·7	1·8
Cumberland bituminous coal consumed per hour, in pounds, ...	2525	2540	2535
Cumberland bituminous coal consumed per 24 hours, in tons, ...	27·054	27.214	27·161
Area of immersed amidship section of hull in sq. ft.,	464·38	464·38	464.38
Displacement of hull in tons of sea water of 2240 pounds, ...	2038	2038	2038
CALCULATED.			
Mean effective steam pressure on pistons in pounds per square inch, ...	14·51	15·53	15.19
Horses power developed by the engines, . .	573·859	565.914	568.424
Slip of the centre of pressure of the paddles in per centums of their speed, ...	12·61	21·84	18·77
Loss of useful effect by the oblique action of the paddles in per centum of the total power applied to the paddles, calculated as the squares of the sines of their angles of incidence on the water,	16·65	16·65	16·65
Pounds of coal consumed per hour per square foot of grate surface, . -	13·173	13.253	13.226
Pounds of coal consumed per hour per square foot of heating surface, ...	0·492	0.495	0.494
Cubic feet of steam of atmospheric pressure furnished per minute, from sea water of twice the natural concentration, with temperature of feed water 100°F, including loss by blowing off to maintain twice the natural concentration, and loss of steam in the cylinders' nozzles, clearance, &c., ...	7456·54	7531·34	7507·76
Pounds of steam evaporated per hour from one square foot of heating surface, from sea water of twice the natural concentration, with temperature of feed water 100° Fahr., including loss by blowing off to maintain twice the natural concentration, and loss of steam in the cylinders' nozzles, clearance, &c., ...	3.208	3.240	3.230
Pounds of steam evaporated per hour by one pound of coal, from sea water of twice the natural concentration, with temperature of feed water 100° F, including loss by blowing off to maintain twice the natural concentration, and loss of steam in the cylinders' nozzles, clearance, &c., .	6·514	6.541	6·532

Indicator Diagrams.—The appended diagrams are given to show the setting and condition of the valves. The leading feature, it will be observed, is a large degree of cushioning, caused by the closing of the exhaust valve before the completion of the stroke.



Nos. 1 and 2 are from the starboard and port cylinders; steam pressure in boilers per gauge, 13·25 pounds per square inch; back pressure in condenser per gauge, 1·7 pounds per square inch; double strokes of engine, 15 per minute; draft of vessel, 16 feet 1 inch forward, and 17 feet 1 inch aft. *Throttle wide.*

Nos. 3 and 4 are from the starboard and port cylinders; steam pressure in boilers per gauge, 14$\frac{1}{2}$ pounds per square inch; double strokes of engine, 15 per minute; draft of vessel, 16 feet 6 inches forward, and 17 feet 1 inch aft. *Throttle $\frac{3}{8}$ths open.*

To be Continued.

For the Journal of the Franklin Institute.

Notice of the Earliest Steam Engines used in the United States. By FREDERICK GRAFF, Esq., Superintendent of Philadelphia Water Works.

(*With a Plate.*)

The following notice of the few steam engines used in this country in the year 1801, with a description of those erected and started in that year at the Centre Square and Schuylkill Water Works, believed to have been the first stationary engines of any considerable size put up in the City of Philadelphia, and probably the first engines of such large dimensions manufactured in this country, may not be uninteresting to the readers of the *Journal.*

The first steam engine of any size appears to have been introduced into America about the year 1763, at the Schuyler copper mine, situated upon the river Passaic, New Jersey. All its principal parts were imported from England, and a Mr. Hornblower (the son it is believed of the well known steam engineer of that time) came to this country, for the purpose of putting up and running the engine.

At the time when the manufacture of the engines for the Water Works was commenced, and as late as the year 1803, we find five engines, in addition to the one mentioned, noticed as being used in this country: two at the Philadelphia Water Works, one just about being started at the Manhattan Water Works, New York, one in Boston, one in Roosevelt's saw mill, New York, and a quite small one used by Oliver Evans to grind plaster of paris in Philadelphia.

The engines for the Philadelphia Water Works were manufactured by Nicholas Roosevelt, at works established by him near the copper mine above referred to, on the river Passaic. Their dimensions were as follows: that at Centre Square had a steam cylinder of thirty-two inches diameter, and six feet stroke, and worked a double acting pump eighteen inches diameter and six feet stroke, raising the water into a tank at the top of the building about fifty-one feet high.

The other engine, situated at the corner of Schuylkill Front and Chesnut streets, had a steam cylinder of forty inches diameter and six feet stroke, and a double acting forcing pump of seventeen and a half inches diameter and six feet stroke, raising the water about fifty-five feet. In both these engines, the lever beams, arms, and shafts of the fly wheels, the bearings upon which the fly wheels are supported, the hot wells, the hot and cold water pumps, the cold water cisterns, and even the steam boilers, were all of wood; in fact, all the engines mentioned above as then in use in America, were supplied with steam generated in wooden boilers.

The following is a description of those used at the Water Works. They were composed of rectangular chests, made of white pine plank, five inches in thickness, were nine feet square at the ends, and fifteen feet long, braced on the outside with oak scantling, and securely bolted together by rods passing through the plank. Inside the chest was a fire box with vertical flues, through which the water passed, the fire acting around them, and passing into an oval flue situated just above the fire box, and carried from the back to the front of the boiler and returned; this fire box was first made of wrought iron with the flues of cast iron, but the unequal contraction and expansion of the two metals caused continual leakage, and eventually wrought iron flues were substituted for those of cast iron. Mr. Latrobe, the engineer who designed the Water Works, claimed great merit for these boilers on account of the non-conducting power of the wood, and for the plan of the vertical flues contained in the fire box. He also gives the following memorandum of the work done by the engines: that at Schuylkill Front street pumping by actual experiment when running sixteen revolutions per minute 1,474,560 ale gallons per twenty-four hours, with a consumption of seventy bushels of Virginia coal; and the Centre Square engine pumping 962,520 ale gallons per twenty-four hours, consuming fifty-five bushels of coal; the pressure of steam ranging from two and a half to four pounds per square inch.

The wooden boilers first put in rotted out in seven years; those at Centre Square being renewed, were used as late as the year 1814. About the end of the year 1803, a new boiler, made totally of cast iron, was erected at the Schuylkill engine house. This boiler had semicircular ends, and was seventeen feet long, eight feet wide at the bottom, and nineteen feet long, and ten feet wide, at near the top. The flame from the fire passed under the bottom, and around the back, into a flue which passed through the boiler and returned, and then around the outside of the boiler to the stack. This boiler was made of cast iron plates, with flanched joints, bolted upon the inside. The drawings of the wooden and iron boilers (Plate VII.) will explain more fully their construction.

The following extract from a Report made to the Watering Committee in July, 1801, by one of its members, who was sent to Roosevelt's manufactory to examine the progress making with the engines, and which describes the boring of the steam cylinder for the Schuylkill engine, gives a very good idea of the state of mechanical knowledge in this country at that time. The Report states that—

> "The large cylinder is cast in two pieces and united by copper, the joint being secured externally by a strong iron band of cast iron, eighteen inches broad, and weighing twelve hundred pounds. Seven thousand five hundred pounds of iron was used to make the cylinder; it is six and a half feet long, and about thirty-eight and a half inches in the bore; about three-quarters of an inch was at first to be cut away. Two men are required; one almost lives in the cylinder, with a hammer in hand, to keep things in order and attend to the steelings; the other attends to the frame on which the cylinder rests, which is moved by suitable machinery; these hands are relieved. The work goes on day and night. One man is also employed to grind the steelings; the work only stands at dinner, and whilst the steelings are being changed, which requires about ten minutes time, and in ten minutes more are dull. I examined some, and found them worn an eighth of an inch in that time. Three steelings, which are about three and a half inches on the edge, are fixed in the head piece at one time; the head piece is a little less than the diameter of the cylinder, and six inches thick, secured on a rod of iron eight inches diameter, which forms the shaft of the water wheel. The workmen state that the boring was commenced on the 9th of April, and has been going on ever since, about three months, and that about six weeks more will be required to finish it."
>
> "Eight or ten hands are employed on the fire box of the boiler; the wrought plates of which it is made are imported from England, are thirty-eight by thirty-two inches; that made in this country is clumsy stuff, of different sizes, the largest being thirty-six inches by eighteen."

This cylinder, after all the labor upon it, proved to be at least three-eighths of an inch larger diameter in the middle of its length, than it was at the ends. What a contrast does this present to the casting and boring done at the present day. I am informed that the cylinders for the Ericsson Caloric engine, eleven feet diameter, and about seven feet long, were bored complete by Messrs. I. P. Morris & Co., of this city, in something less than ten days time.

For the Journal of the Franklin Institute.

James Millholland's Improved Locomotive Boiler; Patented Feb. 17, 1852.

(*With a Plate.*)

Within the past few years, the attention of locomotive builders has been directed to the accomplishment of some plan for the economical and efficient combustion of anthracite coal in locomotive boilers.

Plate VIII. is an accurate engraving of Mr. Millholland's boiler as constructed for this purpose, and now in use on two passenger engines belonging to the Philada., Reading, and Pottsville Railroad Co. The main features of this boiler are, the use of "dust-plates," contracting the area of grate, and intended to prevent overheating on the sides of the fire box; and an intermediate, or mixing chamber, into which the flame and gases resulting from combustion pass from the fire box between "water tables" or vertical water spaces, and from which (after mixing with cold air admitted through small holes) they pass through short tubes into the chimney. In connexion with this arrangement, it will be observed that there are two domes, one over the water tables, and the other over the tubes. From these domes steam is drawn to the engines in equal portions, by the use of a double beat or nearly balanced throttle valve, which seems decidedly preferable to the form of valve usually employed, and diminishes the effect of foaming when a high water level is carried.

The passenger engines above alluded to, have outside cylinders, 14 inches diameter, 2 feet 6 inches stroke; eight wheels:—7 feet drivers.

Dimensions of Boiler.—Length of fire-box, 5 feet 1 inch; thickness of bridge wall, 3½ inches; between bridge wall and front of water tables, 6 inches; length of water tables, 2 feet 6 inches; length of mixing chamber, 1 foot 9 inches; of tubes, 6 feet 6 inches; of smoke box, 2 feet 10½ inches; total, 19 feet 6 inches; diameter of shell, 4 feet; diameter of tubes, 1½ outside, 1·35 inches inside; number of tubes, 264; inner diameter of chimney, 1 foot 10½ inches; diameter of intermediate steam pipe, 3½ inches, of main connecting steam pipe, 5½ inches; height of water tables, 2 feet 8 inches; number of water tables, 9; grate, exclusive of dust plates, 2 feet 10 inches wide × 4 feet 3 inches long; area of grate, 12·12 square feet; nett area of grate between bars, 6·75 square feet; area for draft between water tables, 3·70 square feet; area for draft in tubes, 2·65 square feet; area for draft in chimney, 2·76 square feet; heating surface in fire-box, (over 1 foot above bars,) 55 square feet; in connexion up to water tables, 9 square feet; in water tables, 97 square feet; in mixing chamber, 15 sq. feet; in tubes (outside), 673 square feet; in two tube sheets, 11 square feet; total surface, 860 square feet.

Proportions.—Grate to heating surface, 1·00 to 70·95; grate to flue area between water tables, 3·27 to 1·00; grate to tubes area, 4.57 to 1·00; grate to chimney area, 4·37 to 1·00.

The following particulars of the performance of these engines, which have been in use on the regular traffic for some months, have been communicated by Mr. Millholland.

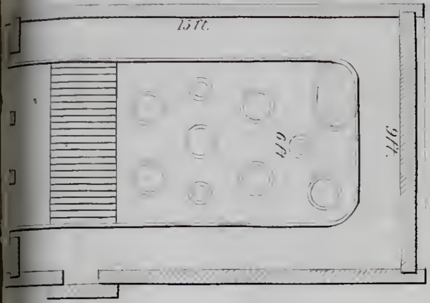
The engines run with trains, 93 miles, making 24 stops, and in addition, they run 3 miles without a train at Philadelphia end of the road; the engine house being located at Columbia Bridge, the engines to take or leave a train have to travel that distance; and at Pottsville, they have about the same distance to travel, making 93 miles with train, and 6 miles without train.

The amount of coal burnt on the round trip, (to Pottsville and back, as above,) is 4 tons, and 24 cubic feet of wood, which includes getting up steam. The amount of wood burnt by an ordinary passenger engine doing the same work, including getting up steam, is 6 cords.

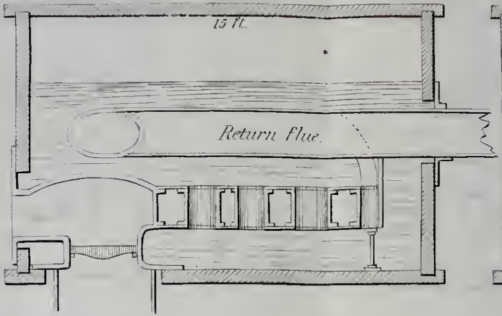
The time required to get up steam from cold water is about 1 hour and 20 minutes.

The pressure of steam carried is about 100 lbs. per square inch, cut off (link motion) generally used at ½-stroke, but varied from ¼th to ¾ths during the trip; average length of time between Pottsville and Philadelphia, urnal Frankli

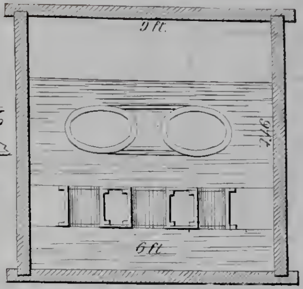
Boilers of the Philadelphia Water Works in 1801.



Plan Section.

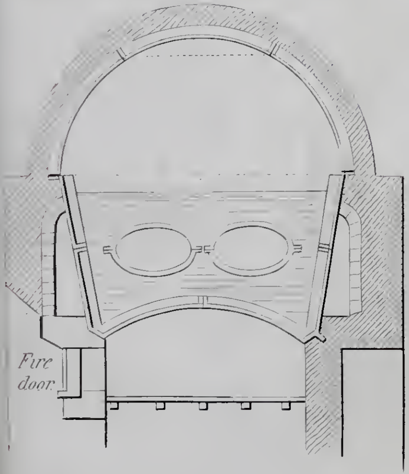


Section through fire box and flues.

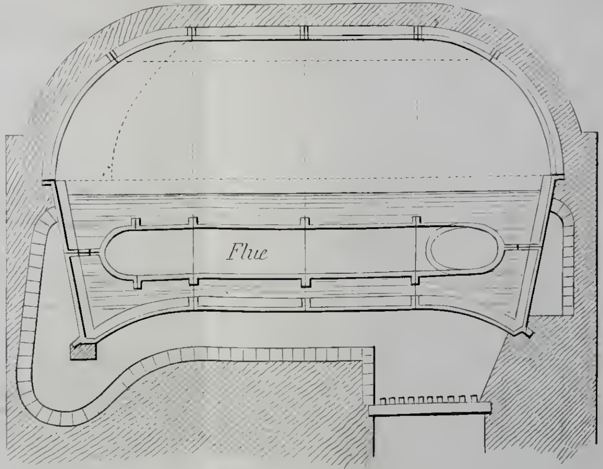


End Section.

End section of the cast iron boiler.



Section through centre of boiler.



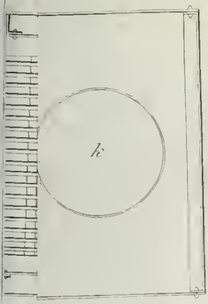
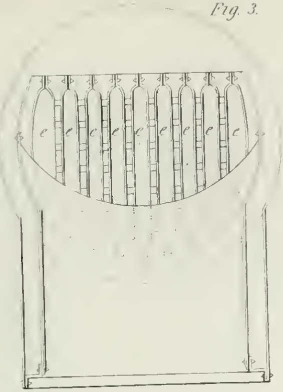


Fig. 3.



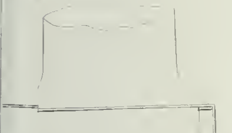


Fig. 4.

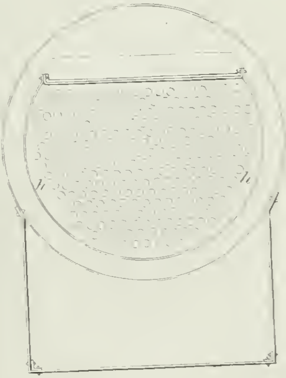


Fig 1.

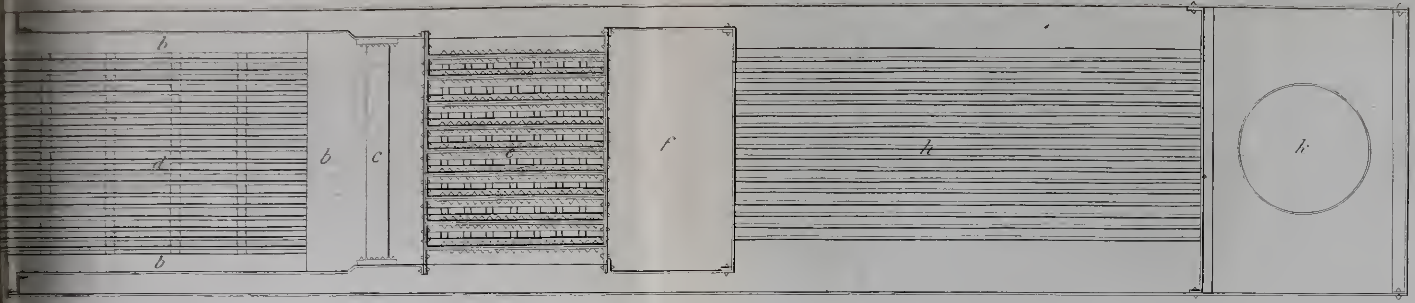
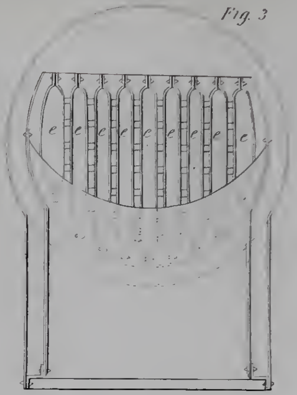


Fig. 3



MILHOLLAND'S

Locomotive Boiler

for

Anthracite Coal.

Fig 2.

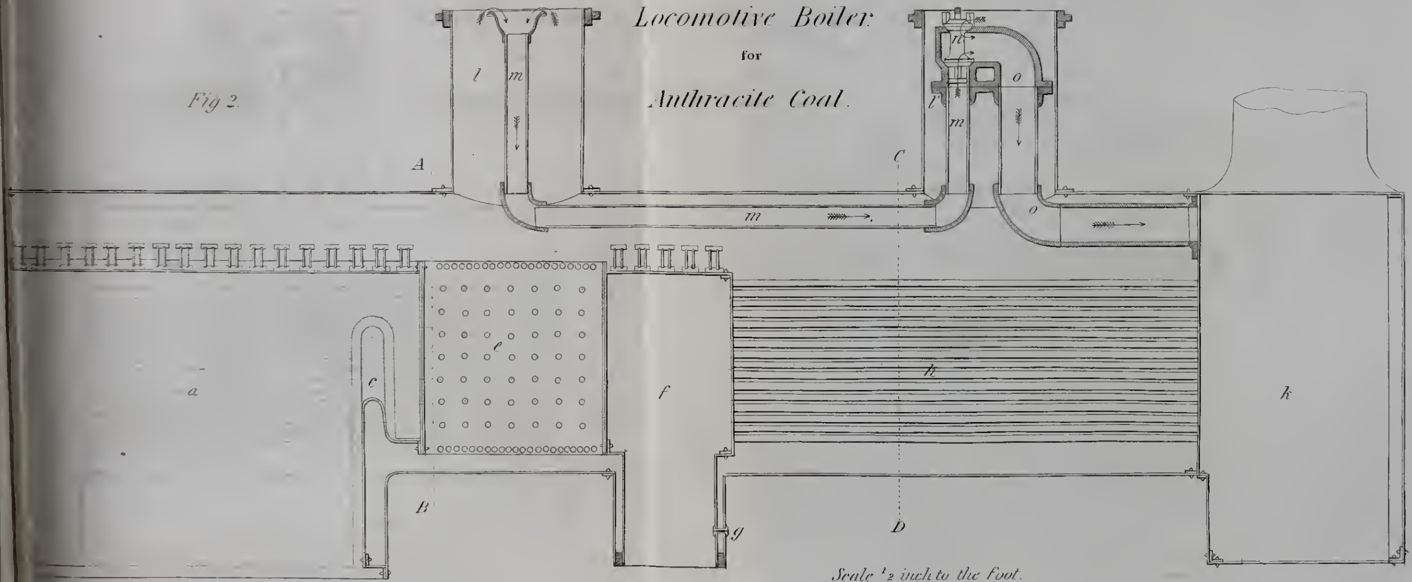
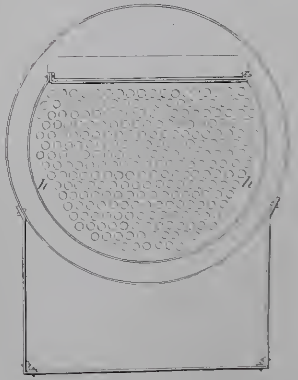


Fig. 4.



Scale ½ inch to the Foot.

4 hours; the time is oftener less than more than four hours, which includes the time in stopping 24 times.

The drawing of this boiler was sent to England in either January or February of 1852.

DESCRIPTION OF PLATE VIII.

Fig. 1. Horizontal section through centre of boiler.
Fig. 2. Vertical " " "
Fig. 3. Vertical transverse section through line A B.
Fig. 4. Vertical " " " C D.
The same letters refer to similar parts in all the figures.

a, fire-box; *b*, *b*, *b*, dust plates; *c*, bridge wall, curved up at sides to give free passage for the steam formed within and below it; *d*, *d*, fire bars; *e*, *e*, water tables braced apart in the flue passages; *f*, mixing chamber for gases, &c.; *g*, 9 openings ¼-inch diameter through socket braces, for inlet of cold air; *h*, *h*, tubes; *k*, smoke box; l, l^1, steam domes; *m*, steam pipe to connect back dome to cylinders; o, steam pipe to connect both domes to cylinder; *n*, double beat throttle valve, regulating the engine, and opening passages to both domes.

First Decision under the New Steamboat Law.[*]

The inspectors of steamboats at Cincinnati, appointed under the new steamboat law passed by Congress, have made a thorough investigation into all the facts touching the recent collision on the Ohio, between the steamers *Falls City* and the *Pittsburg*. The testimony elicited established the following facts: The night was a foggy one when the collision occurred, and the "rules and regulations" requiring "ringing of the bells and blowing the whistle at intervals of two minutes, when running in a fog," were not complied with. Had they been complied with, the collision would not have taken place. As it was, laudable efforts were made by both boats, particularly the *Falls City*, to prevent it. The signal bell of the *Falls City* was tapped twice, signifying her wish to go to the larboard, and that of the *Pittsburg* tapped once, expressing a desire to go to the starboard, but, unfortunately, the signal of the one was not understood by the other. It was also proven that the collision would have been rendered less harmless had both boats instantly stopped on discovering each other. This was done by the *Falls City*, but not so promptly by the *Pittsburg*. In view of all the facts, they acquit the two engineers who were on duty at the time, and suspended for twenty days the license of John White, the pilot of the *Pittsburg*, and the license of Jeremiah Mason, the pilot of the *Falls City*, for ten days, for not observing the rules and regulations. The inspectors state that the penalty in this case is made ight from the fact that the rules are new, and as yet imperfectly understood; but that in all future cases they shall exact the most rigorous penalties of the law.

New Patent Iron Cask.[†]

One of these casks arrived in Liverpool on Friday, from the works of Messrs. Fox, Henderson & Co., for the purpose of being tested here.

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[*] From the North American and United States Gazette, March 9, 1853.

[†] From the London Mechanics' Magazine, November, 1852.

The dimensions of the cask are, 38 inches diameter of head, 43 inches diameter of bilge, and 42 inches length of stave. It was sent to the works of Mr. Thomas Croft, where it was filled with water, and found to contain 214 imperial gallons. An ordinary wood cask of ordinary dimensions would contain only 150 or 160 imperial gallons. When full it was rolled freely over flags and pavement, and found perfectly tight and strong. Afterwards it was lifted from the ground and suspended by ordinary can hooks fixed in the chime ends. It proved perfectly staunch throughout all the trials to which it was subjected.—*Liverpool Albion.*

For the Journal of the Franklin Institute.

Notes on the Trial Trip of the Steamer Carolina.

The particulars of this steamship having been given, p. 140, an account of her performance, on a trial made Feb. 21st, 1853, on the Delaware River, will be interesting.

Ship drawing about 9 ft. but slightly by the head; was laden with 347 tons of coal, water tanks, chains, anchors, a portion of sea stores, empty hogsheads, &c. Time, &c., made was as follows:

	H. M.	Time, Minutes.	Steam, pounds.	Vacuum, inches.	Rev. of engine.	Rev. of Propeller.	THROTTLE.	REMARKS.	Distance in miles.
Passed N. Yard Shears	9 54½		13	26	29	72½		Wind strong ahead.	
" Point House,	10 9½	15	16	26	30½	76¼		Tide flood & there-	2·12
" Fort Mifflin,	10 44	34¼	17	26	31	77½		fore opposed.	6·13
Returning,									8·25
Passed Fort Mifflin,	11 9		32	26	34	85	Partially	Wind in favor	
" Point House,	11 31½	22½	26	26	32	80	shut off.	Tide " "	6·13
" Navy Yard,	11 41	9½	27	26	35	87½	Wide open.		2·12
									8·25

Her speed was therefore as follows, estimating tide current at 2 miles per hour; for the downward trip acting 50 minutes = 1·67 miles more than by shore marks, or whole distance run 8·25+1·67=9·92 miles; upward trip acting 32 minutes = 1·10 miles less than by shore marks, or distance run 8·25 — 1·10=7·15 miles.

Speed downward was therefore 9·92 miles in 49½ minutes = 12·03 miles per hour; average initial pressure of steam 15·65 lbs; vacuum 26 ins.; revolutions of engine, 30·3; of wheel, 75·7 per min.; slip, 8·27 per cent.

Speed upward, 7·15 miles in 32 minutes; or 13.09 miles per hour; average initial pressure of steam, (deduction made for wire drawing,) 22·00 pounds; vacuum 26 inches; revolutions of engine 33·5; of wheel 83·7 per minute; slip 9·76 per cent.

NOTE.—The above data of time, distance, revolutions, and pressure, from the source from which they are derived, are believed to be perfectly reliable; if so, they show a result in economical effect from the engine which it would probably be difficult to surpass.

M.

For the Journal of the Franklin Institute.

Particulars of the Steamer North Star.

New York.—This Steamer was built for Captain Cornelius Vanderbilt. Hull by J. Simonson; machinery, by Allaire Works. Intended service, New York to San Juan de Nicaragua.

HULL.—

Length on deck,	269 feet 6 ins.
Breadth of beam,	38 "
Depth of hold,	29 " 6 "
Length of engine and boiler space,	104 " 6 "
Draft of water,	14 "
Area of immersed midship section,	496·5 sq. feet.
Capacity of coal bunkers,	600 tons.
Draft of water at load line,	14 "
Floor timbers at throats, moulded,	1 " 6 "
" " sided,	10 "
Distance of frames apart,	2 "
Frames filled in solid,	4
Masts and Rig,	Brigantine.

ENGINES.—Two vertical beam.

Diameter of cylinders,	5 feet 6 ins.
Length of stroke.	10 "
Maximum revolutions, (expected,)	16, steam cut off at half stroke.
Weight of engines,	510,000 pounds.

BOILERS.—Four drop flued, with one tier of upper return flues in each.

Length of boilers,	23 feet. 11 ins.
Breadth "	11 "
Height "	10 " 6 "
" steam chimney,	12 "
Number of furnaces,	12
Length of grate bars,	7 " 2 "
Number of flues or tubes in one tier,	6
Internal diameter of flues,	1 " 3½ "
Heating surface,	4892 sq. feet.
Diameter of smoke pipes,	5 "
Height of smoke pipes,	36 "
Maximum pressure of steam,	20 lbs.
Weight of boilers, including smoke pipes,	176,000 "
Description of coal,	Anthracite.

WATER WHEELS.

Diameter,	33 "
Length of blades,	8 "
Depth of blades,	1 " 6 "
Number of blades,	28
Dip of wheels at the above draft,	7 " 9 "

Remarks.—The owner of this vessel intends to take passage in her so soon as completed, and to visit the principal sea ports of Europe, and also those of the Mediterranean sea.

H.

AMERICAN PATENTS.

List of American Patents which issued from Feb. 15th, to March 1st, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

FEBRUARY 15.

17. For an *Improved Adjustable Cut-off Gearing for Puppet Valve Engines;* Horatio Allen and D. G. Wells, City of New York.

Claim.—"What we claim are, 1st, The combination of pawls, with the two arms, whereby the valves are lifted and tripped, as described. 2d, The combination of the arms, provided with rollers, which in their action assist in transferring the pawls from one arm to the other, with the pawls and loose toes, as described. 3d, The making the rollers adjustable with reference to each other, by means of supporting them on independent arms, and connecting them to each other and the arms by means of a right and left screw, whereby the point of cut-off may be altered. 4th, The mode of operating the loose toes by means of pawls and rollers, substantially as herein described and represented. 5th, The mode of working the valves by hand, by means of toes supported on the rock shaft, substantially as herein described and represented."

18. For an *Improvement in Railroad Car Seats;* John Briggs, Boston, Massachusetts.

"The essential feature of my improvements consists in a curved sliding seat, upon which the back rests, which slides in or out, and can be fastened in any desired position."

Claim.—"Having thus described my improvements in car seats, what I claim as my invention is, a seat sliding in an arc formed in the frame work of the chair, and fastened in any desired position, as above set forth, whereby the back is made to follow the motion of the seat, in such manner as to preserve a constant or nearly constant connexion and angle therewith."

19. For an *Improvement in Machines for Manufacturing Harnesses for Looms;* Darius C. Brown, Lowell, Massachusetts.

Claim.—"What I claim as my invention is, 1st, The fliers constructed with a spring nose, or its equivalent, so as to yield the twine, when the needles draw the stitches into the rest, and to take up the binding twine, or draw it tight, when the stitches slip off of the needles. 2d, The apparatus or its equivalent for shoving the eyes off of the rod J', consisting of the cam, slide d^6, lever, rod d^5, and slide e. 3d, The revolving spring nose flier, or its equivalent, in combination with the needle, or its equivalent, for the purposes set forth, substantially as described."

20. For an *Improved Adjustable Heading Lever in Spike Machines;* Joshua C. Carey, Richmond, Virginia.

"The nature of my invention consists in sustaining the heading lever upon a movable fulcrum, so that it shall be capable of a nice adjustment, so as to throw the fulcrum of it to any point, inside or outside of a vertical line, drawn touching the plane of the face of the griping dies, or at a right angle to the spike rod, whereby the machine is enabled to bend the end of the rod up or down, or otherwise, according to the adjustment, and effect the heading of the spike in either direction, in one single motion upon its fulcrum."

Claim.—"Having thus fully described my invention, what I claim therein as new is, sustaining the heading lever upon a movable fulcrum, so as to be capable of adjustment to the requisite distance, inside or outside of a vertical line drawn touching the plane of the face of the griping dies, for effecting the heading of the spike, either up or down, or otherwise, in one single motion upon its fulcrum, substantially as in the manner herein set forth."

21. For an *Improvement in Paging Books;* Richard M. Leslie, Philadelphia, Penn'a.

Claim.—"What I claim as my invention is, 1st, The spring slat type wheels, made after the manner and operating for the purposes described. 2d, The combination and arrangement of the spring slat type wheels, the adjustable posts, sliding arms, spring frame, inking rollers, with their tables, and the rod, with its ratchet and pawls, whereby I am enabled to number one side of four pages by single movement of the treadle, as above described and set forth."

22. For an *Improvement in Artificial Teeth;* Louis F. Sheppard, Alhambra, Illinois.

Claim.—"What I claim as my invention is, extending a suitable metallic plate over the masticating portion of artifical teeth, to protect them more effectually against injury from use, substantially as above described and set forth."

23. For an *Improved Saw Setting Machine;* Rand B. White, Meridian, New York.

Claim.—"Having described the construction and operation of my machine for setting saws, what I claim as my invention is, the combination of the spring hammer with the tooth gauge, both operating in the manner and for the purpose described as set forth."

24. For an *Improvement in Seed Planters;* David and Herman Wolf, Lebanon, Pa.

Claim.—"Having described the construction and operation of our invention and improvement, what we claim as new is, the movable clearer, arranged and operating in the manner and for the purpose herein set forth."

FEBRUARY 22.

25. For an *Improved Apparatus for Separating Ores or other Substances of different Specific Gravities;* Hezekiah Bradford and Elisha Fitzgerald, City of New York.

Claim.—"Having described the invention as it has been applied to the separation of copper ores, any competent machinist will be enabled to apply it to the separation of other substances of different specific gravity from each other. What we claim as our invention is, giving to the reciprocating pan, substantially such as above described, the peculiar motion above described, and by the means substantially as herein described. We also claim giving the back movement to the said pan in a less period of time than the forward movement, by means of a crank or cranks, whose axis of motion is below or above the plane of motion of the rear end of said pan, or by equivalent means, as described, and for the purpose specified. We also claim, in combination with a pan having the motion or either of the motions substantially such as specified, and on which the ore, &c., mixed in water, is supplied at some point towards the middle or back, the employment of a current or currents of water descending the inclined or curved surface of the said pan, in the manner and for the purpose substantially as specified. We also claim making the rear end of the said pan with an inclination or curve upwards, substantially as specified, and for the purpose set forth. We also claim making the said pan operated as specified, with apertures back of the place where the substances to be separated are applied, for the purpose and in the manner substantially as set forth. And, finally, we claim making the front and rear ends, or either, of the pan having a vibratory motion, with a gradual curve downwards, substantially as specified, when the same is employed in combination with currents of water, substantially as and for the purpose specified."

26. For an *Improvement in Gas Meters;* Alexander A. Croll, London, England.

Claim.—"What I claim as my invention is, the mode of arranging movable partitions or plates, so that the flexible material at the circumference of the plates shall not be bent but in one direction, substantially as set forth. And I also claim the arrangement and combination of the arms with the valves and movable plates of a dry meter, as set forth."

27. For an *Improvement in Sewing Machines;* William H. Johnson, Greenville, Assignor to William G. Bates, Westfield, Massachusetts.

Claim.—"Having described my invention, what I claim is, the making of the double loop stitch, having the loops upon one side of the cloth, by means of two needles, combined and operating substantially as herein fully described. I also claim the making a seam, or uniting two pieces of cloth, by means of the double loop stitch herein fully described, consisting of a plain stitch from a single thread on one side, and on the other, of a continuous chain formed of a succession of double loops from two threads."

28. For an *Improvement in Scythe Fastenings;* Alpheus Kimball, Fitchburg, Mass.

"My invention consists in an improvement upon a scythe fastening patented by E. S. Clapp."

Claim.—"What I claim as my invention is, the method of securing the blade of the scythe to the snath, by passing its shank through the end of the stationary metal cap, and securing it by means of the upward pressure of the screw, in combination with the claw and bush piece, constructed and operating in the manner substantially as described."

29. For *Improvements in Suspending, Lowering, and Liberating Ships' Boats;* Wm. S. Lacon, Great Yarmouth, England; patented in England, February 23, 1852.

Claim.—"Having now set forth my invention, and the manner of carrying the same into effect, I wish it to be understood that I do not confine myself to the precise arrangement of apparatus above described for carrying out my invention; but I claim suspending ships' boats, by having the chains or ropes so connected with drums or barrels, substantially as specified, that the two ends of the boat shall descend together, and with equal or nearly equal velocity, and so that the chains or ropes shall be free to disengage themselves from the barrels, in combination with the mode of controlling the turning of the barrels, by the weight of the boat, &c., substantially as specified."

30. For an *Improvement in Mortising Machines;* James Moreland, Adrian, Michigan.

Claim.—"Having fully described my improved apparatus, what I claim therein as new is, the combination of the cross bar on the cross head with the projecting dog on the movable way, for the purpose of withdrawing the chisel from the wood, on the back motion of the cross head, substantially as set forth."

31. For an *Improvement in Cut-off Motion for Looms;* Amos B. Taylor, Mystic, Connecticut, and Stephen Wilson, Jr., Westerly, Rhode Island.

Claim.—"We do not claim the roller against the warp, by which the position of the weight is regulated; neither do we claim the ratchet wheel and worm pinion, moved by a pawl or click from the lay, as these have before been used. What we desire to secure is, effecting and regulating the let-off motion by the variable counterpoise lever, in combination with the sliding worm pinion, when said worm pinion is acted on by the yarn beam, through a direct strain communicated to it by the tension of the warp; the whole arranged and combined in the manner specified."

32. For an *Improvement in Machines for Turning Irregular Forms;* Lauren Ward (Administrator of Richard Ward, deceased), Jerome B. Hubbell, and Hart C. Hubbell, Naugatuck, Connecticut.

. *Claim.*—"We are aware that machines have been made for turning irregular shapes, by means of sliding centres, grooves, guides, patterns, cams, &c., and that cutters have been so formed and arranged as to assist the cams, &c., in giving the shape to the article; we therefore do not claim either of these, as such, as our invention: but what we claim as our invention is, the use of a cutter wheel for turning irregular forms, the cutters being so arranged that the pattern may be disclosed in reverse on its surface, when combined with the feed motion herein described, so that in turning said cutter wheel the desired irregular shape will be given to the article, without using guides or patterns, when the whole is constructed, arranged, combined, and made to operate, substantially as herein described."

Re-Issues for February, 1853.

1. For an *Improvement in Apparatus for Discharging Water from the Holds of Vessels;* Nehemiah Hodge, North Adams, Massachusetts; patented October 19, 1852; re-issued February 1, 1853.

Claim.—"I do not intend to confine my invention to the precise form or forms of its parts, as above described or as represented, but intend to vary the same, or any of the same, in any manner, while I do not change the principle or novel feature or character claimed as new, or as my said invention. I lay no claim to the invention of the system of "pendulum or swinging gutters," invented by M. Morel, and described in Belidor's Treatise on Hydraulics; nor the hydraulic machine of A. De Courdemoy, as described at page 205 of the first volume of Machines and Inventions approved by the Royal Academy of France, printed in 1735. But what I claim as my invention is, the combination of a system of two series of chambers, connecting pipes, discharging pipe, receiving hole or orifice, and ventilating pipes, as arranged, connected, applied to the hold of a navigable vessel, and made to operate during the rolling or pitching movements thereof, substantially in manner and for the purpose of elevating and discharging water therefrom, as herein above set forth."

2. For an *Improvement in Excluding Dust from Railroad Cars;* Edward Hamilton, Bridgeport, Connecticut, Assignor to Henry B. Goodyear, Administrator of Nelson Goodyear, deceased; patented May 27, 1851; re-issued February 15, 1853.

Claim.—"I do not wish to be understood as limiting myself to the mode of application herein specified, but to cover all modes which are substantially the same, and which operate on the same principle. What I claim as my invention is, inducing outward currents of air through the windows of railroad cars, to prevent the entrance of dust, &c., by the action of the surrounding air on deflectors combined with the sides of the car, substantially as specified, and operating on the principle set forth."

DESIGNS FOR FEBRUARY, 1853.

1. For a *Parlor Stove;* James H. Conklin, City of New York, Assignor to William P. Cresson, Philadelphia, Pennsylvania; February 1; ante-dated December 13, 1852.

Claim.—"I do not claim the peculiar form of this stove, or any of the ornaments separately; but what I do claim is, the combination and arrangement of the ornamental forms and figures represented in the accompanying drawings, and forming together an ornamental design for a parlor stove."

2. For a *Sewing Bird;* Charles Waterman, Meriden, Conn., February 15.

Claim.—"What I claim is, the design herein represented by the feathered bird upon the wing, bearing a burden upon its back."

3. For a *Cradle;* Alexander Edmonds, Mount Pulaski, Illinois, February 22.

Claim.—"What I claim as my production is, the design and configuration of the ornaments above described and set forth, forming together an ornamental design for a horological cradle."

MARCH 1.

1. For an *Improvement in Bedstead Fastenings;* Asa N. & Alden Case, Gustavus, O.

Claim.—"We do not claim the pawl and ratchet as our invention; but what we do claim as new and our improvement is, the combination of the inclined plane, and head, with the pawl and ratchet, for the purpose of fastening bedsteads and tightening the cord, in the manner specified."

2. For an *Improvement in Swiveled Nibbed Keys for Door Locks;* Augustus C. Harig, Louisville, Kentucky.

Claim.—"I am aware that the nib of the key has been fitted into the tubular shank, and so secured therein by a pin fitting into a groove, that the burglar's instrument when applied to the nib would rotate it without moving the key, and in connexion therewith; I am also aware that the key, by a plate attached to the inner lock plate, has been held, so that it could not be rotated; and I therefore do not claim these devices. But what I do claim as of my invention is, the guard bit attached to the swivel nib, in combination with the ordinary bit and shank of the key, constructed and operating substantially as herein set forth."

3. For *Improvements in Rotary Steam Engines;* James McKay, Philadelphia, Pa.

Claim.—"What I claim as my invention is, the passages for the exhaust steam, arranged so that they shall cover and encircle the entire periphery of the stationary cylinder, and have their ingress and egress openings so arranged as to cause the exhaust steam, as it escapes, to envelop the whole surface of the cylinder, as described. In combination with the ordinary valves and parts which form a passage for the steam to and from the engine, I claim the supplemental exhaust parts and valves, which act in conjunction with the ordinary exhaust valves, whereby a free egress for the exhaust steam is afforded, without leaving large open passages for the steam to waste in. I also claim the combination of the sliding pistons with self-adjusting valves and steam ways, which admit a portion of the steam that propels the piston, behind its inner end, to act as a spring to press it out into the steam space, whichever way the engine may be turning. I also claim mounting or hanging the two cylinders on radial and axial journals, respectively arranged in a common plane, and at right angles to each other, whereby the two cylinders can accommodate themselves to each other, so as to avoid binding, substantially as herein set forth."

4. For an *Improved Machine for making Axes;* Jonas Simmons, Cohoes, New York.

Claim.—"I do not claim the employment of rolling dies for shaping an axe; but I claim the arrangement of the devices above mentioned for making axes, viz: rolling dies, with a rest bar to support the iron whilst being rolled, and an eye bar, arranged not only to serve as a mandrel to shape the eye of the axe, but with the rest bar to hold the iron firm during the process of rolling, the rest bar and eye bar being connected with the machinery to give them appropriate movements, to cause them to co-operate with the rolls in shaping the axe, and these parts further in combination with a scarfing bar, for the purpose of shaping the blade to receive the steel point, in order to complete the axe, substantially as the same is set forth in the within specification."

5. For an *Improved Supplemental Valve in Reciprocating Steam Engines;* Charles A. Spring, Kensington, Pennsylvania.

Claim.—"What I claim as my invention is, the arrangement of a valve in the lid of the steam chest, or the equivalent thereof, between the cylinder of a steam engine and the boiler, in such manner that it will prevent the reflux of the lead steam, by closing whenever the pressure of the steam in the engine exceeds that in the boiler, and opening again whenever the pressure in the boiler is greater, substantially as herein set forth."

6. For an *Improvement in Looms;* William Townshend, Hinsdale, Massachusetts.

Claim.—"I do not claim actuating the pickers by the backward motion of the lay alone; but what I do claim is, 1st, The cam wheel l, on the chain shaft 31, right angle lever l', and staples or slide bolts 36 and 37, combined and acting as described and shown, to bring the picking motion into operation alternately on each side, by the backward motion of the lay, as specified. 2d, I claim actuating the picker staffs by the lay, on its backward motion, by means of the vibrating studs, when combined with levers 40 and 45, attached to the swords of the lay, and bent levers m and m', the whole arranged and combined in the manner described. 3d, I claim the levers o^2 and o^3, connected together by the adjustable pin, so as to give greater or less motion to the selvage warp, when actuated by the cam o, as described and shown. 4th, I claim the apron or straps 62, connected to the bar s, and kept to the cloth by the proper weight or power, so as to cause sufficient friction to wind the cloth on the cloth beam, when said apron and bar are moved or actuated from the lay or otherwise, so as to produce the effects herein described and shown."

7. For an *Improvement in Bedstead Fastenings;* E. Sumner Taylor, Cleveland, Ohio.

Claim.—"I do not claim separately the pawl and ratchet, nor a continuous right and left hand thread or screw; but what I do claim as my improvement is, the combination of the pawl and ratchet with the spiral grooved sections attached to the tenons, arranged and applied in the manner and for the purpose herein specified, namely, the tenons of one side rail and one end rail being furnished with the plates having the spiral groove turning to the right and left as described, turning in the direction of the arrows, and making a tight joint with the post; the other side and end rails having on their tenons a groove, passing around the tenon at right angles to the axis, and fitting the pins as described, so that by having one side of the tenon on each end, flattened, to enable it to pass the pin, in order to allow it to enter the groove, when, by turning in either direction less than a complete revolution, the pin fitting into the groove prevents the posts and rails from separating; and by attaching the ratchets to the end of this side rail and one end of the end rail, with the pawls attached to the posts as specified, by tightening of the cord, put on in the manner described; the whole frame of the bedstead is held firmly together by the combined action of all the parts described, one end rail and one side rail remaining stationary, the other end rail and side rail turning as described, for the purpose of tightening the cord, both being secured by the pawl and ratchet."

8. For an *Improvement in the Construction of Curry Combs;* William Wheeler, Troy, New York.

Claim.—"What I claim as new is, the application of a ring, loop, or fixture on curry combs, for the insertion of a thumb as a guard and rest therefor, the ring or loop being made in one piece with the back strap, as set forth."

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, March 17, 1853.

Samuel V. Merrick, President, in the chair.
Thomas Fletcher, Vice President.
John F. Frazer, Treasurer.
Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from The Royal Astronomical Society, London; L. Lea, Esq., United States Commissioner of Indian

Affairs, Hon. David Dale Owen, United States Geologist, Hon. Joseph R. Chandler, United States Congress, and The Smithsonian Institution, Washington City, D. C.; Dr. W. T. G. Morton, and George C. Rand, Esq., Boston, Massachusetts; William J. McAlpine, Albany, New York; the American Institute, City of New York; The Young Men's Mercantile Library Association, Cincinnati, Ohio; and from Messrs. A. Hart, Solomon W. Roberts, Birkinbine & Trotter, A. B. Hutton, Dr. Thomas S. Kirkbride, Chas. E. Smith, Harvey Tuckett, and Dr. B. Howard Rand, Philadelphia.

Donations to the Cabinet from The Brooklyn Flint Glass Company, New York; Dr. L. Turnbull, and Edward Miller, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of February.

The Board of Managers and Standing Committees reported their minutes.

The Actuary reported the organization of the Board of Managers, and the Standing Committees for the ensuing year, by the election of their chairmen and appointing the time for holding their stated meetings, as follows:

Managers,	Alan Wood,	Chairman,	2nd Wednesday	Evening.
Committees.				
On Meteorology,	Owen Evans,	do	1st Monday	do
" Library,	Wm. A. Rolin,	do	1st Tuesday	do
" Models,	John A. Wimer,	do	1st Thursday	do
" Exhibitions,	John E. Addicks,	do	do	do
" Minerals & Geol. Specimens,	J. C. Trautwine,	do	2d Monday	do
" Meetings,	Dr. B. H. Rand,	do	do	do
" Arts and Manufactures,	Prof. J. C. Booth,	do	2d Tuesday	do
" Science and the Arts,	Prof. J. C. Cresson,	do	2d Thursday	do

New candidates for membership in the Institute (3) were proposed, and the candidates (6) proposed at the last meeting were duly elected.

Dr. Rand, Chairman of the Committee on Meetings, exhibited and described Mr. James J. Clark's self-winding telegraph register.

In this instrument the moving power of the drum on which the paper is coiled, is a spring, instead of a weight, as in the ordinary register. This spring, which is coiled on the shaft of the drum, is maintained at a constant tension, by means of a galvanic battery attached to the apparatus; a break circuit wheel is connected with the drum; each time the circuit is completed an electro magnet fixed on the base of the instrument attracts its armature, which is attached to one end of a lever, at the other end of which is a pawl which moves a ratchet wheel forward one tooth. The motion of this rachet wheel is communicated to the shaft of the drum, upon which the spring is coiled. The whole is so adjusted that the spring shall thus be wound up as fast as it runs down in turning the drum, and a perfect uniformity in the motion of the latter is secured. The tension of the spring may be altered in a few moments, without interfering with the action of the instrument.

(A detailed description of this apparatus will be published in a future number.)

Dr. Rand also exhibited Billings and Ambrose's carriage axle. The axle is grooved near its outer end; into the groove two sliding plates having a horizontally projecting tooth upon the outer end of each, and compressed in grooves in the outer end of the hub, are slipped. The teeth upon the end of these plates are confined in grooves cut spirally in the face of a cam plate, in such a way that by turning the said plate in one direction or the other, the said shifting plates are forced in or withdrawn, and so form the connexion between the hub and the axle. Over the end of the hub is a covering cap, through the centre of which is a hole for the insertion of a key into the aforesaid cam; so that while the end of the hub is covered, the simple rotating movement of this key locks or unlocks the wheel and the axle.

Frederick Graff, Esq., Superintendent of the Fairmount Water Works, presented a portion of the wooden boiler in use at the works, in Centre Square, from 1801 to 1814, and which supplied steam for a forty horse power engine, carrying four and a half pounds pressure to the square inch. (Mr. Graff's description of this boiler will be found on pages 269-70-71.)

G. W. Smith, Esq., suggested that some use might be made of the heat of the water discharged from the hot well of stationary condensing steam engines which at present runs to waste, by the introduction of a number of small thin tubes, into a box filled with this hot water; the atmosphere passing through these tubes would absorb much of the heat, and pass immediately into the closed ash pit, in a state suitable to facilitate combustion and economize the heated products; the expense of these tubes might preclude their adoption where fuel is cheap.

Mr. J. Vaughan Merrick admitted that some saving of fuel might be the result, but considered that as the difference in temperature between the water in the hot well and that of the atmosphere would not be great, so large an amount of surface would be required as to make it doubtful whether the first cost, or space required for such an apparatus, would be repaid. He alluded to the plan adopted by Prof. W. R. Johnson, in his experiments on coals, of compelling the air to pass through openings in the side walls of the boiler setting before reaching the grate, as being more feasible. In those experiments the air entered the grate at a temperature generally higher than 212°.

Mr. Smith also called the attention of the members to a drawing of a design for an ornamental stand pipe, by Messrs. Birkinbine & Trotter.

Dr. C. M. Wetherill called the attention of the members to a modification of Kemp's thermostat.

A full description of this instrument will be published in a future number of the *Journal.*

Dr. Turnbull exhibited to the meeting a specimen of *galmel* or silicate of zinc, presented to the Institute by Edward Miller, Esq., obtained from Saucon Valley, Lehigh County, Penn'a. The crystals were small, tinted of a yellow color, associated with a portion of carbonate of zinc. It is a valuable ore of zinc, and is employed in the manufacture of brass. It could be used for preparing the zinc paint by precipitation, as it is readily soluble in acids, when the silica gelatinizes, and can be separated. It contains about 60 per cent. of metallic zinc.

Dr. Turnbull also brought to the notice of the meeting a specimen of *magnetite*, or magnetic oxide of iron, from Lake Superior. The ore was of a very fine quality; lustre, metallic; color, iron black; crystals, octahedral, mixed with garnet, which combination is considered highly advantageous for the reduction of this variety of ore, granular ores often requiring no other flux.

Mr. Barlow exhibited a model of Mr. Parker's system for banding pulleys, as used for driving a circular saw. In this arrangement the power is communicated to the belt by friction between pulleys, instead of friction over the driving pulley as usual. On the driving shaft a large pulley is keyed; near the centre of this shaft is pivotted a frame, carrying at the other end a second pulley, smaller than the first, which approaches that of the driver as it is moved in the direction in which the power is exerted; between the circumference of these two the belt is compressed, and passing back around about one-fourth the periphery of the larger wheel, returns over the saw pulley, whose axis is as near as possible to that of the driver. By this arrangement the belt is tightened as the power is increased, and the space required is much less than by the common method, since the belt may be shortened to one-fourth the circumference of the driving pulley.

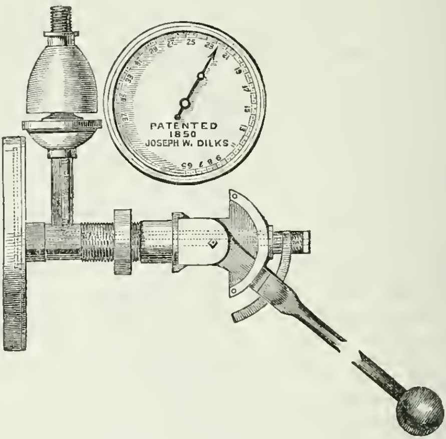
Geo. W. Smith, Esq., presented two dioptric fixed light apparatus for ship's lanterns, each cast in one piece of flint glass, at the Brooklyn Flint Glass Works, Long Island, New York. They are very economical, compared with the ground glass dioptric lanterns, and intercept less light, and might be advantageously used for many purposes, viz: for piers, signal stations, street lamps, &c. Mr. Smith reminded the meeting that a few years ago he had suggested a modification of the form of lens for fixed lights, viz: the substitution of the meniscus or concavo-convex form in section, in lieu of the ordinary plano-convex lens. The advantages he proposed thereby were, first, the more direct incidence of the light from the lamp on the glass, and the less loss by reflection; second, the less diameter, both above and below, of the aperture of the drum, which enables it to intercept a larger portion of the emitted sphere of light. A less number of catadioptric rings would be required, and those of a smaller diameter than usual. The meniscal drums were made at the same works in Brooklyn, and all the curves calculated there by one of the employees of the Company. Mr. Smith believed that they were the first constructed on this plan which he had suggested. They were presented by the Company through Mr. Gilliland.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on J. & J. Dilks' Improvement in a Gauge for indicating the height of Water in Steam Boilers.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improvement in a Gauge for indicating the height of water in steam boilers," invented by Messrs. J. & J. Dilks, of Philadelphia, Pennsylvania—Report:

That an instrument similar in principle to this was formerly presented to the Committee for examination, by Mr. Jos. Dilks, and was favorably reported on. As it was feared by many, however, that the form of instrument then shown would be unfavorably influenced by the pressure of the steam on its slides, the Messrs. Dilks have modified it, and offer it in its present form. As now constructed, the gauge consists of a plug of brass, which passes through the head of the boiler, to which it is attached by a proper screw. The axis of the plug is hollow, and in it is fitted a cylindrical rod, which terminates exteriorly in an index hand, which traverses a dial, and is protected by a glass face, as may be seen by the drawing.



The inner end of the plug is ground flat and true, and is covered with a plate fixed upon the rod; this plate being carefully ground, acts as a slide to prevent the access of the steam to the hollow axis of the plug through which the rod passes. Beyond this circular slide, the rod carries a pinion, and beyond this its extremity rests in a bearing supported from the plug, against which a spiral spring wound around the rod also abuts, which by its pressure is intended to keep the slide always firmly against the surface of the plug. To the side of the plug, the arm of the float is attached by a pivot, and carries a toothed quadrant so placed that its teeth shall gear into the leaves of the pinion on the rod of the index. It will be easily seen that by this adjustment, when the water in the boiler, and consequently the float, sinks, the index hand, by means of its rod and pinion, and the toothed rack on the float arm, will be moved in one way; when the water rises, it will be moved in the opposite direction; and these changes are clearly indicated in the graduated dial. At one point of the circular slide, a deep notch is cut in its circumference, and this notch is so placed that when the water has sunk so far as to reach a dangerous level, the notch corresponds to a second orifice drilled through the plug, and terminating outside in a steam whistle. By this means the existence of danger will be notified to the engineer and all others whom it may concern.

The Committee regard the gauge of Messrs. Dilks as simple and efficient. Like the magnetic gauge of Mr. Faber, it indicates the level of the water by means of a float, and dispenses with the stuffing box, (which was the former objection to this method of indicating,) and appeals at every moment to the eye of the engine man, without requiring any experiment, as with the gauge cock and the percussion gauge, to show the level of the water. It is easy of construction and cheap, and can be easily and speedily removed at any time, when the boiler is not in actual use, for examination, or repair if it should need it, although it does not seem liable to get out of order, since it may be placed at any desired height above the water level. It also possesses the advantage, that by a simple and obvious mechanism outside of the boiler, its indication of the water level may be transmitted to any place, and the manager of an establishment may thus have under his eye in his office the state of the water in all the boilers under his charge.

The recent improvement introduced by Messrs. Dilks in the application of their principle, will much diminish the liability to stick, if such existed in the original form, by diminishing the area of the surfaces in contact; and the Committee believe that the constant oscillations of the surface of the water in the boiler will obviate all danger of this occurring.

The Committee, therefore, regarding the invention as useful and ingenious, and believing it to be new, recommend the award of the Scott's Legacy Premium to the Messrs. Dilks for their water gauge.

By order of the Committee,

Wm. Hamilton, *Actuary*.

Philadelphia, February 10th, 1853.

Report on Mr. Richards' Improvement on the Stereoscope.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improvement on the Stereoscope," invented by Mr. F. De B. Richards, of Philadelphia, Pennsylvania—Report:

That, as will be seen by the letter of Mr. Richards, appended hereto, he claims for his arrangement of the Stereoscope four advantages, viz:

First. "Leaving the box open for a short space at the back, so that the light can fall upon the picture properly, when the body is upright." This arrangement is undoubtedly advantageous, inasmuch as it not only relieves the body from a constrained position, but also allows more light to fall upon the picture than can frequently be gained in the usual construction. It is, however, not new, as a very favorite form of the instrument has been the skeleton stereoscope, in which the whole upper part and sides are open to the light.

Secondly. The "increase of the focal distance and power of the lenses, so as to take in much larger pictures than formerly, which pictures I have found by experience have to be taken at a different angle from those for smaller instruments." This enlargement of the capacity of the instrument is undoubtedly in many cases an advantage; but as it is obtained simply by increasing the focal distance and power of the lenses, cannot be considered as an invention, although it may be a very happy suggestion.

Thirdly. "The placing at the back of the instrument a screw, to lessen or increase the distance of the picture from the lenses, so as to suit any focus." The Committee consider this arrangement as constituting a very great improvement, the ordinary mode of accomplishing this end by drawing out the tube in front, being, as Mr. Richards remarks, apt to throw the lenses out of adjustment, when attempted by those not familiar with the instrument.

Fourthly. "The placing a rack and pinion or lever in front, by means of which the distance between the lenses may be widened or lessened, so as to bring their centres in a line with the centres of the eyes; thus obviating the straining effort which many persons have to use in viewing pictures through the ordinary instrument."

Mr. Richards considers this as the most important of his improvements, and the advantage of it will easily be seen by any one who will try the experiment by altering the adjustment as indicated. It is believed that this means of adjustment has been before applied to opera glasses, but the employment in the stereoscope the Committee consider as new and valuable.

On the whole, the Committee consider Mr. Richards' form of the stereoscope as an ingenious and improved modification of the ordinary instrument, and recommend that a description of it be published in the Journal of the Institute.

By order of the Committee.

Wm. Hamilton, *Actuary.*

Philadelphia, February 10, 1853.

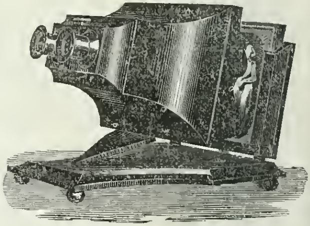
To the Committee on Science and the Arts of the Franklin Institute.

Gentlemen:—I offer for your consideration some explanation of the Stereoscope I had on exhibition at the Franklin Institute, and what I consider my improvements.

1. In the imported instruments, and all that I have seen, the light is admitted to the picture by a small opening at the top; to view the picture, you have to bend the neck and body over, which is a very unpleasant position. This I obviate by leaving the box open for a very short space at the back, so that the light can fall upon the picture properly when the body is upright.

2. I have increased the focal distance & power of the lenses, so as to take in much larger pictures than formerly, which pictures I have found by experience have to be taken at a different angle from those for small instruments.

3. I have placed at the back of the instrument a screw, so as to lessen or increase the distance of the picture from the lenses, so as to suit any focus. The same alteration has been made by drawing out the tube in front: there is a great objection to this, as those not familiar with the instrument are apt to throw the lenses off their centres.



4. That which I consider the most important of all the changes I have made is, placing a rack and pinion or a lever in front, by which means I

widen or lessen the distance between the lenses, so as to bring their centres on a line with the centres of the eyes; thus obviating that straining effort which many persons have to use in viewing pictures in the ordinary instrument.

I remain your obedient servant,
F. De B. Richards.

Philadelphia, Nov. 4, 1852.

BIBLIOGRAPHICAL NOTICES.

Principles of Organic and Physiological Chemistry. By Dr. Carl Löwig. Translated by Daniel Breed, M. D. Philadelphia: A. Hart, late Carey & Hart: 1853.

For many years the principal part of the attention of the most eminent chemists has been given to the subject of Organic Chemistry. The analogies existing between compounds of organic bodies and those which occur between bodies of an inorganic nature, were too many and too close to allow of a doubt that both classes were subject to the same general laws, and that a full exposition of chemical science must comprise them both; while, on the other hand, the differences arising from few elements, the most complicated combinations, and the difficulty or impossibility of forming them at pleasure, indicated the existence of new conditions, and the interference of other attractions.

So great were the difficulties in pursuing these studies, that, although we owe to older chemists many able and valuable memoirs upon isolated groups and genera of organic compounds, no serious attempt to form a theory appears before our own time, when Berzelius, Liebig, Laurent, Dumas, and others propounded various general modes of viewing the complex phenomena of this branch of their science. Partial as was the success of these hypotheses, and manifest as were the discrepancies among them, it became at least certain that a law existed, and might be attained, and the perseverance of the many and able chemists, especially of the German and French schools, has pursued the subject indefatigably and not unsuccessfully.

Among the most eminent of these, the author of the present treatise holds a well recognised place. Science already owes to him an invaluable treatise on the *Chemistry of Organic Combinations*, and in the work before us we are presented with his views as to the theory of the products of these combinations. The treatise is intended rather for the mature student or the Professor, than for the ordinary class of learners; but we are sure that no one of any class whose chemical education has enabled him to read the work, will rise from its perusal without great profit. The views of Prof. Löwig are generally marked by great expansion and clearness, and although there is occasionally a trace of the German disposition to mysticism and over-refinement, yet they are in general simple and forcible. Considered merely as a hypothesis, or a convenient artificial memory for the student, we consider it as the best we have seen, although much meditation and much experimental investigation will be necessary before it can be definitely accepted as the true expression of nature.

It presents moreover to the chemist here, the advantage of being the first book in the English language which has given in their proper places the most recent discoveries in Organic Chemistry, which are so valuable both in their theoretical and practical bearings.

As to the translation: It is good in so much as it gives the idea of the original, and generally in such a way as to be comprehended, though sometimes requiring more attention for this purpose than was necessary. It presents as a *book* the very great fault of a want of sufficient familiarity with the English, and a marked preference for German forms of speech, which renders the book harsh to the ear, and sometimes difficult to understand. An endeavor to translate every word of the original (including expletives) literally, has made the book less pleasant and less easy to read than it might have been. But we are thankful both to author and translator that it is no worse.

The book is well got out by the publishers, and will form a very valuable if not indispensable addition to every chemist's study.

The Practical Brass and Iron Founder's Guide, &c. By James Larkin. Philadelphia: A. Hart, late Carey and Hart, Publisher, 126 Chesnut st.

We are pleased to notice the publication of this little work, which is exceedingly well got up, and reflects, in that respect, credit upon the publisher. It is a compendium of various information valuable to the class of men for whose benefit it is published, and being written by a practical man who has himself felt the want of a similar work, and who contributes from his own experience, will no doubt be received with favor. The properties and capabilities of various metals and of their compounds, the proportions of each required for different kinds of work, recipes for making plaster or wax casts, lacquering work, &c., and various tables, of use not only to the brass founder, but to all metal workers, are among the numerous items named in the table of contents.

Mr. Larkin has performed his part of the work so well that perhaps we have no right to complain of any omissions. We shall only suggest that in future editions, the author would do well to add some information respecting the manner of moulding different kinds of work, the material used in the moulds, and other items connected with the management of a brass foundry. We observe also that Mr. Larkin describes in his article on brass guns, only the method of moulding employed in England and the Continent; whereas the American plan of making a wooden pattern (moulded and cast on end) as used by Alger and by Kemble, at Boston and West Point, is simpler and cheaper, while the article produced is certainly as good, and said to be superior to that made by the English method. However, it is always easy to point out omissions, and to make suggestions. Taking the work as it stands, we have no doubt it will meet with a rapid sale, and be found a useful hand-book of reference.

M.

Errata.

Page 206, line 13 from top, for "one inclined," &c., read "two inclined," &c.
" 210, " 4 from bottom, for "rim," read "iron."
" 210, bottom line, for "rim," read "iron."

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MAY, 1853.

CIVIL ENGINEERING.

Extract from the Report of the Board of Trade on Railways, for the year 1851.—*Accidents, their Causes and Means of Prevention.**

(Continued from page 222.)

It is to be observed that an improper use of the discretion allowed to the driver not only endangers the safety of the train which he himself is conducting, but in a greater degree that of the trains in front and rear of his own train. It might be impossible to provide a time table for these trains for any length of time before the trains are run, but it is worthy of consideration whether the responsibility as to the hours at which trains are to pass along each railway or part of a railway in either direction should not be placed upon one person, who should be a responsible officer of the Company, without whose permission no engine or train should be allowed to pass along the railway.

The attention of the late Board of Commissioners of Railways, and of your lordships, has been particularly directed to this subject by accidents that occurred during the year 1851.

Upon the occurrence of an accident of a very serious nature upon the Great Western Railway, where it appeared that an excursion train had been along the line of railway, unprovided with a time table, the Commissioners pointed out to the company how desirable it is, not only on account of the comfort and convenience of the passengers, but also with a view to their safety, that these excursion trains, in which the numbers carried are so very great, should be conducted with the utmost regularity; and that arrangements should be made for them along the lines on which they travel, so that their hour of arrival and departure at all stations should be fixed and known beforehand.

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*From Herapath's Journal, No. 706.

In like manner, in communicating to the London and North Western Railway Company, the result of the investigation into a serious accident that occurred at Bicester, the Commissioners urged upon the Directors the great necessity of working their excursion traffic with the utmost regularity. They observed that these excursion trains are generally advertised some days before the public are conveyed by them, and they suggested that there could, consequently, be no difficulty in arranging so that they might be worked throughout their journey to time tables, in the same manner as the ordinary trains, and supplied in every respect with all requisites to secure for them as safe and regular a journey as those trains. In reference to this subject, it is right to observe, that the manager of the London and North Western Railway, whose experience in these matters must give great weight to his opinion, considered that the nature of the traffic during the extraordinary season of 1851 rendered it impossible to fix any specified time for the transit of these trains. The question is one, however, which requires constant and careful consideration, as it cannot be doubted that the taste for this description of amusement having been once acquired in the country, it will continue to a very great extent.

The preceding observations, which are equally applicable to several other cases in which accidents have occurred, have reference particularly to those accidents in which one of the elements concurring to produce them has been the absence of time tables; this is especially to be observed on some railways with reference to goods and mineral trains; but another circumstance which tends alike to produce danger is, that when time tables are provided, the trains are not worked with punctuality to the times denoted in them. This want of punctuality may arise from several causes:

1. From an improper arrangement of the times in the tables, either from not taking sufficiently into account the character of the line itself or the detentions to which particular trains are subject at particular stations. The remedy in this case can always be applied by re-adjusting the time tables experimentally, until they suit the condition of the line and the requirements of the traffic.

2. From the motive power not being sufficient to allow of the appointed times being kept. The deficiency may arise either from the excessive weight of trains or from atmospheric causes, such as damp or frost, by which a bad state of rails is induced and the adhesive power of the engines diminished, or it may arise from very boisterous weather. The remedy in this case is equally evident; no engine should be tasked to do more than it has adequate power to do with certainty at all times and in all ordinary conditions of weather. It being impossible in a long journey to calculate upon the changes and vicissitudes to which a train may be subject from the weather, it would appear but right that the maximum of load to be drawn by any given engine should never exceed the minimum of power to be depended upon under all conditions not of an extraordinary character. On this point, it seems hardly necessary to observe that the locomotive engine is a machine which will permit of very great

accuracy in the performance of its work, and will, if not unfairly tasked, work with as much certainty as a well regulated timepiece.

The simple method for reducing such a rule to practice is, that companies should ascertain, either experimentally or otherwise, this precise load, with reference to the conditions of the particular railway, and the nature and speed of the traffic each engine is intended to convey, which might be registered and known by the driver of the engine, and should on no account be exceeded. Such a provision corresponds with that usually inserted in the bye-laws of railway Companies, by which they book passengers at roadside stations, or stations intermediate between the terminal stations, conditionally upon there being sufficient room for them in the trains.

3. Want of punctuality may arise from purely accidental failures of machinery, such as the fracture of some part of the engine. These causes of delay appear to be comparatively of very rare occurrence.

It only remains to advert to the cases in which inattention to regulations or carelessness of the servants of the Company are involved. It would appear that in 23 out of 41 cases, into the circumstances attending which investigations were made, considerations of this nature were involved.

These may be divided under two distinct denominations:—

1st. Occasional. Those caused by inexperience or carelessness of individuals.

2. Habitual. Those caused by general inattention to regulations on the part of the servants of the Company, exhibiting, as a natural consequence, a laxity of discipline throughout the whole management of the railway.

On this subject, as to which it is very difficult to give any accurate statement, and to separate the two classes, it appears that there is much ground for apprehension that on some railways the disregard of regulations is habitual, and the general discipline lax, from the fact that breaches of the regulations issued by the Directors of Railway Companies for the guidance of their servants are of very frequent occurrence under the immediate supervision of the superior officers of the railways, and in which many of them participate, or of which at any rate they are cognisant. This may be induced by the regulations themselves not being very explicit, as appears to have been the case in some of these accidents, as, for instance, the collision that occurred on the Eastern Counties Railway at Ponder's End, on the 8th January, 1851; or by defective supervision and inspection on the part of the railway Companies over their servants, such as would appear to have been the case upon the Midland Railway, as shown by the accidents, the reports and correspondence relative to which are to be found in Appendices 48 to 53.

Discipline upon railways is of the greatest importance both to the public and to the Companies, who are subject by the occurrence of serious accidents, to great losses, and to the payment of compensation to injured persons; but notwithstanding the direct interest which the Companies thus have in maintaining discipline, and enforcing the regulations which they themselves have considered necessary for the safe conduct of the traffic upon their lines, it has been the duty both of the Commissioners of of Railways and of the Lords of this Committee to animadvert in some cases in very pointed terms upon the neglect of these regulations.

It is a subject to which it is desirable that the attention of railway Companies should be especially called, both as affecting the safety of the public, and the profits of their undertakings, as the only security the public can have in this respect is in the Companies themselves, who alone have the power, by the adoption of carefully considered regulations and careful supervision, to enforce an efficient state of discipline.

It appears advisable, in considering this question, that some few observations should be made upon a proposition which is considered by many as holding out a prospect of obtaining a greater degree of safety upon railways, viz., to prescribe an interval of time to be observed upon all railways between succeeding trains, and which should at all times be strictly enforced.

This proposition, as has been stated above, has been adopted on some railways, but for the reasons there given does not appear alone to afford a sufficient security for the safe working of a railway. There are other reasons why any rule as to this interval could not be generally applied. The object to be gained in fixing an interval of time between trains following each other upon the same line of rails is, that upon an accident occurring by which the stoppage of a train is occasioned, and the line of railway obstructed, there shall be sufficient time to admit of a signal being sent out to protect the rear of the train that is stopped. This time must depend on the nature of the signal. In fine weather a light or a flag is employed, according as the necessity for its use may arise, by night or by day, which may be seen for a considerable distance, provided the view be unobstructed either by curves or objects in the vicinity of the railway. In foggy or thick weather a detonating signal is attached to the rail, which, upon being exploded by the passage of an engine, gives a loud report, and thus communicates the required signal to the driver.

This latter signal requires that the man, whose duty it is to fix it should actually have arrived at the place where the signal first becomes available, and is, therefore, the most unfavorable condition under which signals can be applied.

Upon the people in charge of a train receiving a signal to stop, it is their duty to apply the means provided upon the train for arresting its progress with the greatest alacrity. The distance to be traversed by the train before it will come to rest will depend, first, upon the alacrity with which the means are applied, and, secondly, upon the extent of these means as compared with the weight and speed of the train, taking also into consideration the inclinations and curves upon the line, and the condition of the weather.

The distance, therefore, from any obstacle at which a signal must be given in order to secure the safety of the traffic, requires to be ascertained with reference to each railway, and the weight of engines and trains in general use upon it, the speeds at which they travel, and the means for arresting their progress provided upon each train.

The interval between succeeding trains should be made up, therefore,

1st. Of the time consumed in stopping the first train;

2d. Of the time consumed by the guard or man who is responsible for applying the signals, in going out to the required distance with those signals. This time, in a case in which considerations of public safety are involved, should be determined under the most unfavorable conditions in which the signals can require to be applied, such as a dense fog.

A liberal margin should, however, be allowed in each consideration in the interval so calculated, which will seldom be less then ten minutes, and may be more. Upon railways where the means provided for arresting the progress of a train are very powerful, it might be reduced.

Few Companies adopt a less interval than ten minutes; all, however, have rules by which it is imperative upon their servants to exhibit at all signal-stations, the "Danger" or "Stop" signal for a certain interval after the passing of every train, so as to prevent at each of these points, which average a distance of not more than three miles apart on all the railways in the kingdom, a diminution in the interval considered necessary by the managers of the railways to be maintained between the trains.

In any regulations of this nature, as in all others that may be adopted, safety would still depend upon the vigilance of the servants of the Companies, and the efficiency of the machinery.

From these considerations it appears manifest, that to prescribe a certain fixed interval of time applicable alike to all trains, taking the responsibility out of the hands of the Companies, would be improper, as each line, with its gradients and curves, and the train arrangements in force upon it, would require separate consideration. To enforce upon all Companies an uniform regulation in this respect would, moreover, be unjust; for upon a line of light traffic, where trains do not succeed each other with great rapidity, fewer servants may be employed upon the trains, and fewer brakes used for stopping the trains, a longer interval of time being adopted; whereas, upon a line of heavy traffic railway Companies may find it in their interest occasionally to station men within signalling distance along the line of railway, in order to save the time consumed by a guard running out with and placing his signal when his train shall, from any cause, have been obliged to stop.

The prescription of a minimum interval, as deduced from a line of great traffic, would tend to diminish rather than increase safety in traveling, as it might lead those Companies which do not use the precautions employed upon the line of great traffic to adopt the minimum interval without examination of the data and details upon which it was founded, and so relieve them, in a great degree, of that responsibility which should attach to them.

Probably one of the best means that can be recommended for promoting the safety of the public upon railways is an extended use of the electric telegraph, by means of which the traffic upon a railway may be so worked that no two trains shall be upon the same part of the line between neighboring telegraph stations at the same time. All lines do not possess this adjunct to their establishment, which requires a considerable outlay of capital, and a large establishment of clerks. Upon some lines the telegraph stations are not sufficiently near to one another to allow of its being used for this purpose, so that, although the use of the telegraph may, no doubt, be very much extended, its adoption upon all lines, and its employment in the manner here described, cannot be enforced.

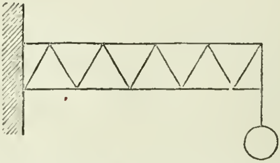
An Investigation of the Strain upon the Diagonals of Lattice Beams, with the resulting Formulæ.

By WILLIAM THOMAS DOYNE, Assoc. Inst. C. E., and WILLIAM BINDON BLOOD, A. B.*

Continued from page 228.

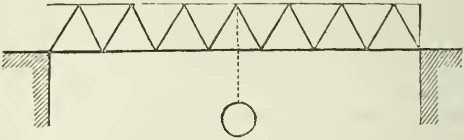
Appendix.—Most of the following formulæ, giving the strains upon the diagonal bars of diagonally-framed beams, were arrived at before the construction of the model, which was made for the purpose of practically verifying them. The formulæ are given without any mathematical demonstration, as this is easily supplied by those who desire it.

Fig. 3.



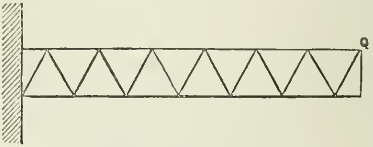
Case I. (fig. 3.) Semi-beam loaded at the extremity. Let $w =$ weight, $\pi =$ length of diagonal bar, $d =$ depth of beam, $\Sigma =$ strain of diagonal; then $\Sigma = w\frac{\pi}{d}$, and is uniform throughout the beam.

Fig. 4.



Case II. (fig. 4.) Beam supported at the ends and loaded in the middle: then $\Sigma = \frac{1}{2}\,w\frac{\pi}{d}$, also uniform.

Fig. 5.



Case III. (fig. 5.) Semi-beam uniformly loaded. Let $\mu =$ load on unit of length, $k =$ distance of diagonal from Q; then $\Sigma = \mu k\frac{\pi}{d}$, varies as k.

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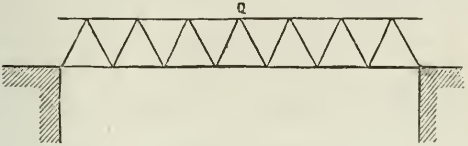
* From the London Civil Engineer and Architect's Journal, January, 1853.

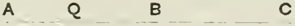
Case IV. (fig. 6.) Beam supported at the ends and uniformly loaded. Let k = distance from Q, the centre; then $\Sigma = \mu k \frac{\pi}{d}$.

Fig. 6.



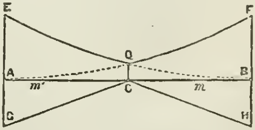
It is easy to extend these formulæ to the cases of continuous beams; thus—

Fig. 7.



Case V. (fig. 7.) In a beam AC, supported at the ends and the middle point, and uniformly loaded; let Q be the point of maximum horizontal strain, AQ being $\frac{3}{8}$ of AB; and k = distance from Q; then $\Sigma = \mu k \frac{\pi}{d}$. Thus the strain increases uniformly from Q both ways to A and B, where it is a maximum. This formula applies to all cases of continuous beams, k being always measured from the point of maximum horizontal strain in each span. In all these cases of uniform loading, k is measured to the upper end of the diagonal, if the load be attached to the bottom of the beam; to the lower end of the diagonal, if the load rest on the top of the beam; and to the middle point of the diagonal, if the load be supported equally by top and bottom.

Fig. 8.



Case VI. (fig. 8.) Let A B be a beam of diagonal framing supported at A and B. Suppose a train of uniform weight, and whose length is not less than A B, to move from A towards B. The maximum strain on a diagonal, at any point (m) in the half C B, is when the front of the train is at (m), and the maximum strain at (m) is when the tail of the train is at (m). The strain on a diagonal at the middle point C is a maximum when an end of the train is at C. These maximum strains are proportional to the ordinates of the parabolas E Q and Q F, whose vertices are at B and A respectively, and in which the ordinates A E and B F represent the strains at the extremities with uniform load. The strain at (m) varies as $\overline{Am}^2$; at (m') as $\overline{Bm'}^2$. If, therefore, A E and B F be taken to represent the strains due to a uniform load of greatest density (say engines), and if A G and B H be taken equal to the strains due to the weight of the bridge itself, and the parabolas E Q and Q F and the lines C G and C H be drawn, the ordinates of the figure G E Q F H C will represent the greatest possible strains upon the several diagonals. From this it appears that the greatest possible strain at the centre is one-fourth of that at the ends, due to the moving load alone.

To express these strains by formulæ, let $k = Cm\ Cm'$, $l = AB$, $\pi =$ length of diagonal bar, $d =$ depth of beam, $\mu =$ density of constant load, $\mu' =$ density of moving load, $\Sigma =$ strain on diagonal; then

$$\Sigma = \mu k \frac{\pi}{d} + \mu' \frac{(\frac{1}{2}l + k)^2}{2l} \cdot \frac{\pi}{d}.$$

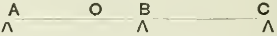
If $k = o$ we have at the middle point $\Sigma = \frac{1}{8}\mu' l \frac{\pi}{d}$.

If $k = \frac{1}{2}l$ we have at the ends $\Sigma = \frac{1}{2}(\mu + \mu') l \frac{\pi}{d}$.

If the length of the train be less than A B, the effect will be to diminish some of the strains towards the ends, so that the foregoing diagram and formulæ cover every case.

With respect to continuous beams there is one point deserving of notice, viz: the case of unequal loading of the different spans. This is important, because it diminishes the advantage derived from continuity in all cases of moving loads. For instance—

Fig. 9.



Case VII. (fig. 9.) In the case of a beam supported at the ends and middle point, if $\mu =$ unit of load on A B, $\mu' =$ unit of load on B C, O the point of contrary flexure; then,

$$AO = \frac{7\mu - \mu'}{8\mu} \cdot l;$$

$$\text{The pressure on } A = \frac{7\mu - \mu'}{16} \cdot l;$$

$$\text{“ “ } B = \tfrac{5}{8}(\mu + \mu') \cdot l;$$

$$\text{“ “ } C = \frac{7\mu' - \mu}{16} \cdot l.$$

The horizontal strain in A O is greater (if μ be greater than μ') than when the spans are equally loaded, and the diagonals towards A are more strained, and those towards B less so.

Analogous formulæ may be derived for the other cases of continuous beams. As an example, suppose a beam over two spans of 120 feet each. With an uniform load, the point of contrary flexure is 90 feet from the extremity. But if the load on one span is double that on the other, this point is 97·5 feet from the extremity of the beam. Several very careful experiments have been made upon the deflexion of steel bars, to test the accuracy of these formulæ, and of those for the case of a beam on four supports. The results of these were very satisfactory, the measured deflexions agreeing very closely with those calculated from the formulæ.

Discussion.—Mr. Doyne said his advocacy of the system of lattice construction was based upon careful theoretical investigation and practical experience, both by experiments on a sufficiently large scale and by the construction of bridges of a considerable span. He had determined to enter thoroughly into the investigation of the subject, and therefore had, in conjunction with Mr. Blood, so constructed the large model as that each strut and tie could be removed, and, by the substitution of a dynamometer, the strain in any part could be measured. The experiments were in all cases made before the calculations, and the coincidence between the results was remarkable. It would be observed that the model exhibited equally well the effects of an uniform or of a partial load, and as from the construction the action of the struts and ties could not be reversed, all the variation of the strains consequent on the varying load must be rendered palpable. Since this investigation had been made, Mr. Doyne had constructed for the Aberdare Iron Company a bridge on this principle, of 140 feet span, for carrying a railway over the river Taff. It was originally intended only to bear one line of rails; but two lines had been laid down; the depth of the girders was 12 ft. 6 in.; the lattice-bars were made of plain flat rolled iron 3 inches by $\frac{1}{2}$-inch for 14 feet in the centre, and 4 inches by $\frac{1}{2}$-inch for 14 feet at each end, put together with rivets 1 inch in diameter. The bridge had frequently been loaded with 75 tons, which would give a strain of $6\frac{1}{4}$ tons per square inch of section on the bars. There was a regular traffic of about 100,000 tons per annum over it. As to the cost of construction, the Aberdare Company supplied the iron to Messrs. Brown, Lennox, and Co., who put the girders together on the spot, and raised them up to their positions by hydraulic press power. The total weight of iron employed was 53 tons, and the cost of the bridge was 11*l.* 10*s.* per ton nett, which was 4*l.* 7*s.* per foot run of the span, exclusive of the cost of erection and carriage. Now, comparing this with the box-beam girder—the sectional area of the top and bottom must be identical in either case, and Mr. Doyne must contend that the method of uniting them by the diagonal struts and ties, which were comparatively small pieces of cheap and easily-handled rolled merchant bar-iron, simply punched at the ends and at the intersections for the rivets, was a simpler and easier system than riveting together a number of sheets of iron, which, taking weight for weight to cover that area, would be barely $\frac{3}{8}$-inch in thickness, and would therefore require nearly as much more metal for the angle-irons, the overlap of the plates, and the stays, to give the connecting web stiffness and to prevent from buckling. Besides, there would be a considerable saving in the first cost of common bars as compared with boiler-plates, and the cost of labor must certainly be less in the diagonal construction than in the plate-iron riveted web; thus he contended that theoretically and practically, for girders of all dimensions, the system he had advocated did possess important advantages.

Mr. P. W. Barlow said he had used girders of the triangular construction, and was well satisfied with them, both as to cost and strength: for spans of moderate dimensions, he preferred the simple equilateral triangulation to the more complicated system of lattice-work; the calculation of the strength was easy, and that form offered great facility for construction.

Mr. Doyne explained that his reason for adopting the lattice form instead of the simple triangulation was, that with deep girders smaller sized bars and rivets were required, inasmuch as the points of suspension and attachment were closer together with the lattice system than with the simple triangulation, for which latter construction, in the case of wide spans, large dimensions of iron must be adopted, the pins would require to be very strong, and the holes must be cut out by expensive machines, instead of by a simple punching-press. In deep girders it was convenient to place the platform or roadway midway of the depth, which just suited the lattice form, but was not so convenient with the simple triangulation. He had only used the simple triangulation for spans not exceeding 60 feet, and generally for shallow girders, but he believed that some girders had been made on Captain Warren's plan for much greater spans. The question between the simple and the close triangulation was, in a great measure, one of comparative cost of construction, and he was inclined in favor of the lattice form, chiefly because of its facility and economy.

Captain O'Brien directed attention to a bridge erected by Mr. Osborne at Ballysimon, on the Waterford and Limerick Railway. The principle of construction was stated to be simple, each girder consisting of a top and bottom sill, kept apart by cast or wrought iron diagonal struts, intersecting each other and forming a double triangulation, with wrought-iron ties through the abutting pieces of each pair of struts. The platform was carried by transverse timber beams laid on the bottom sill; the clear span was 86 feet, and the cost, exclusive of the cross beams and platform, was 1289*l*. Bridges on this principle of 50 feet span had been erected complete for 625*l*. It was stated that there was not any dead weight or useless material, that the pieces composing the girders were mere duplicates of each other, were easy to be handled, and required no skill in adjusting; the beams might be dead level or be slightly cambered; they occasioned no thrust on the abutments, as they rested on rollers, to allow for contraction and expansion; the deflection of the bridge of 86 feet span was only $\frac{5}{16}$ inch, when tested by a weight of 80 tons.

Mr. Doyne objected to the system of construction of the bridge just referred to, as under a varying load some parts were completely relieved from pressure, whilst the others had an undue proportion thrown on them. Under all circumstances some of the struts were relieved from strain, which was borne by the ties; therefore the material employed in those struts was not only unserviceable, but it added to the load on the bridge.

Mr. C. May directed attention to a bridge designed by Mr. J. Cubitt, on the single triangulation principle, constructed by Messrs. Fox, Henderson, and Co., for carrying the Great Northern Railway across Newark Dyke: the span 250 feet, and the diagonal ties nearly 17 feet long.

Mr. Hawkshaw said he had constructed many lattice bridges of various spans; an enumeration of a few of them, with some of their leading particulars, would suffice to give an idea of them:—The Paddock viaduct near Huddersfield, which was 80 feet high, was constructed in its centre part of continuous beams of malleable iron lattice work 345 feet in length, 7 feet deep, and spanning four openings, each of 80 feet clear width. The viaduct was built for two lines of rail; there was one girder under each rail and one on each side, forming the fence, making six girders altogether; they were braced transversely with lattice bracing, and the girders were covered with a planking 6 inches thick, laid transversely. The breaking weight of the girders, treating them as separate girders over each opening, was rather more than three times a load of 1½ ton per lineal foot on each line of way, and the cost of the iron work complete at 20*l.* per ton was 15*l.* per lineal foot. The bridge over the Leeds and Liverpool canal and the canal wharf at Liverpool were also constructed of malleable iron lattice-work, differently disposed from that at Paddock. These bridges were in situations where there was only a depth of 2 feet between the level of the rails and the headway required to be left beneath the line of the whole width of the openings. There were four openings, one of 120 feet span, one of 112 feet span, and two of 70 feet span each. Each opening was spanned by two double lattice-girders, one on each side of the lines of way; transverse plate-iron girders 15 inches in depth were bolted to the bottom of these, and on them the two lines of railway were laid. The large girders for the span of 120 feet were 12 feet deep in the centre, and diminished to 6 feet in depth at the ends. The other girders were proportionably of less dimensions. In all these segmental lattice-bridges the breaking weight was calculated at fully four times a load of 1½ ton per lineal foot on each line of way. The cost per lineal foot, at 17*l.* per ton, was—in the 120 feet span, 28*l.*; in the 112 feet span, 25*l.*; in the 70 feet span, 17*l.* The lattice was in many cases a convenient and economical mode of connecting the top and the bottom ribs of a girder; the simplest and cheapest application of the principle was when the platform could be placed on the girder; it was also less subject to casualty than when the platform was placed at some distance up the sides.

Mr. Brunel said that in considering this question it was necessary to draw a distinct line of demarcation between the lattice-bridge and that kind of construction called Warren's girder; in the former much of the material employed was useless, whilst in the latter, if properly proportioned, every part was made to perform its duty, either bearing pressure or intension; he was inclined to think it might be rendered nearly the most economical as well as the most efficient kind of girder for spans of a certain extent.

Mr. Rendel said, that Mr. C. H. Wild had recently investigated carefully for him the proportions and scantlings of some bridges on Warren's principle, intended to carry the lines of railway in India, for which locality their simplicity of construction, being composed of multiples of a few parts, the ease with which they could be transported to their destination, and the facility of putting them together, peculiarly fitted them. They were also cheap: a bridge of a span of 220 feet would cost about 15 per cent. less than a lattice-bridge for the same span. It was necessary not to confound the two principles, as the Warren girder was decidedly superior to the lattice-bridge.

On Longitudinal Compression of Materials.

Results of Late Experiments upon the Resistance to Compression of various Substances of the Dimensions of one Cubic Inch.

Materials.	Weight in lbs.	Materials.	Weight in lbs.	Loss by freezing in 10·000 of an oz.
METALS.		STONES, &c.		
Cast iron, gun metal,	105·000	Granite, Patapsco,	11·200	
Wrought iron,	116·000	*Sandstone, Aquia Creek,	5·340	
begins to yield,	40·000	† " Seneca,	10·764	
Brass, fine,	164·800	" Aquia Creek, strata, laid horizontally,	8·332	
Copper, cast,	117·000	‡Marble, Stockbridge,	10·382	8·8
Tin, cast,	15·550	§ " East Chester,	23·917	6·2
Lead,	7·730	‖ " Symington, large crystals,	11·156	
WOODS.		" same, strata horizontal,	10·124	
Oak,	4·500	" same, strata vertical,	9·124	
Pine,	1·930	" same, fine crystals,	18·248	
Elm,	1·290	" Italian,	12·624	
STONES, &c.		" Lee, Mass.,	22·702	9·9
		" Hastings, N. Y.,	18·941	11·8
Gneiss,	19·680	" Montgomery co., Penn.,	8·950	8·8
Brick, hard,	4·368	" Baltimore, large crystal,	8·057	21·9
common,	4·000	" " small crystal,	18·061	8·1
fire,	....			

*Same as that of the Capitol, Treasury Department, and Patent Office, Wash., D. C.
† " " " Smithsonian Institute.
‡ " " " City Hall, New York.
§ " " " General Post Office, Washington, D. C.
‖ " " " National Washington Monument.

Resistance of Stones, &c., to the Effects of Freezing.—Various experiperiments show that the power of stones, &c., to resist the effects of freezing, is a fair exponent of that to resist compression.

For the Journal of the Franklin Institute.

Report of Experiments on Gunpowder, made at the Washington Arsenal in 1843 *and* 1844. By Capt. ALFRED MORDECAI, U. S. Army.

The following selection of results and properties of gunpowder, the loss of force by windage, the effects of wadding, &c., &c., was made by Charles H. Haswell, Marine Engineer, for insertion in a new edition of his Engineers and Mechanics' Pocket-book, and as it was impracticable for him to appropriate any more space for this subject than that required for the essential elements involved in the general varieties of powder, &c., &c., he was constrained to give but a partial selection of the varieties of powder experimented with.

The report of Capt. Mordecai embraces the results of careful systematic observations effected with the aid of a cannon and musket pendulum, and is of a character not only to manifest his suitability for the labor so judiciously confided to him, but to reflect high honors upon the corps of which he is so distinguished a member.

of Results and Properties of Gunpowder, determined by the Experiments and Report of Capt. A. Mordecai, U. S. Army.

24-Pounder Gun.—Weight of ball and wad, 24·25 lbs.; weight of powder, 6 lbs.; windage of ball, ·135 inch.
Musket Pendulum.—Weight of ball, 397·5 grains; weight of powder, 120 grains; windage of ball, ·05 inch.

Kind of grain.	Composition.			Manufacture.		Number of grains in ten Troy grains.	Relative quickness of burning.	Water absorbed by exposure to air.	Relative force. Standard = 1000.				Weight of a cubic foot, loose.	Designation of powder in the experiments.
									24-Pounder gun.		Musket Pendulum.			
	Saltpetre.	Charcoal.	Sulphur.	Where from.	Glazing.				Initial velocity in feet.	Force.	Initial velocity in feet.	Force.		
								Per ct.	Per sec.		Per sec.		Oz.	
Cannon, large, .	76	14	10	Dupont's Mills, Wilmington, Delaware.	Glazed.	77	275	2·27	1710	964	....	677	916	A 1
small, .					"	569	314	3·35	1659	935	....	720	927	3
Musket, . .					"	1134	211	....	....	....	1484	808	896	4
Rifle, . .					"	6174	142	....	....	....	....	907	...	5
Rifle, . . .					"	5344	282	3·55	1668	940	....	728	1044	E 5
Musket, . .					"	1642	...	....	....	....	....	834	937	X p 4
Rifle, . .					"	13152	...	....	....	....	....	943	955	p 5
Sporting, . .				Esquerades, French,	"	....	...	....	....	....	....	935	...	French.
Cannon, uneven,	75	12·5	12·5	Dupont's Mills, Delaware,	Rough.	166	183	2·09	....	....	....	788	780	F
large, .					"	103	182	1·91	1552	8715	....	756	775	1
medium, .					"	163	186	2·95	1527	861	....	768	751	2
very large, even					"	211	200	....	1504	848	....	740	762	0
Sporting, . .	77	13	10	Dupont's Mills, Delaware,	Highly glazed.	72808	100	4·42	1774	1000	1888	1000	1047	G 6
Blasting, uneven,	70	15	15		Glazed.	295	212	....	1660	936	....	....	917	S
Cannon, medium,	76	13·7	10·3	Garesché, Delaware,	"	191	216	2·69	....	....	....	754	879	B 2
Rifle, . .	76	15	9	Loomises, Hazard & Co., Connecticut,	"	2378	204	....	....	....	....	820	934	C 5
Sporting, . .					"	....	...	....	....	....	....	888	...	6
Cannon, uneven,	75	15	10	Waltham Abbey, England,	"	174	...	....	....	....	....	731	872	English.
Musket, . .					"	2832	...	....	....	....	....	841	814	"
Rifle, . .					"	11600	...	....	....	....	....	865	820	"
Sporting, . .	...	...	...	J. Hall & Sons, Dartford, Eng.,	"	....	...	....	....	....	....	980	...	"
Cannon, uneven,	75	12·5	12·5	Bouchet, France,	Rough.	316	...	....	....	....	....	835	804	French.
Musket, . .						2110	...	....	....	....	....	796	830	"
Musket, . .				Stockholm, Sweden.	Glazed.	....	...	....	....	....	....	742	...	Swedish.

Note.—The report of Capt. Mordecai embraced a greater number of specimens, and furnished other elements. A selection only has been made of such qualities of powder, results, &c., as are considered essential for general purposes.

Table showing the Increase of weight in 1 *lb. of various kinds of Gunpowder, exposed to Moisture for a period of* 17 *days.*

Kind of powder.	Increase of Weight.	Kind of powder.	Increase of Weight.	Kind of powder.	Increase of Weight.
	Per cent.		Per cent.		Per cent.
A 1	2·77	E 5	3·55	F 2	2·95
3	3·35	F	2·09	G 6	4·42
B 2	2·685	F 1	1·91		

The powders A and B were slightly caked by this exposure; E much more so; the F's were not at all caked; and the G became hard caked on the surface after 6 days' exposure.

Table showing the Relative Force, by the Musket Pendulum, of various kinds of Gunpowder in good order, and of the same Powders dried, after Exposure to Air saturated with Moisture.

Kind of powder.	Powder in good order.	Powder dried after exposure to moisture.			Loss of force by the exposure.	Gain of force by the exposure.
	Initial velocity of ball.	Moisture absorbed.	Absorb'd moisture retained.	Initial velocity of ball.		
	Feet.	Per cent.	Per cent.	Feet.	Per cent.	Per cent.
A 1	1256	20·88	·83	891	29·06	....
A 4	1499	23·25	·29	1480	1·27	....
A 5	1648	27·05	·31	1516	9·98	....
E 5	1351	23·11	0·	1472	....	8·96
F 1	1404	20·83	0·	1315	6·34	....
F 0	1373	22·59	·20	1143	16·75	....
G 6	1856	19·53	0·	1472	20·69	....

The least dense powders return nearest to their original strength. The gain by the powder E 5 arose from the circumstance that the density of it in its original state was so great as to impede its combustion; hence, the grain becoming swollen by exposure to moisture, and its density correspondingly diminished, its combustibility was increased in a greater degree than its strength was impaired by the moisture.

In a large charge, like to that of a 24-pound gun, Captain Mordecai thinks the result would not be the same.

Table showing the loss of Force by Windage.

24-POUNDER GUN.

Powder.	Ball.	Initial velocity of ball in feet per second.			
		Without windage.	Windage. ·135 inches.	Windage. ·245 inches.	Windage. ·355 inches.
Pounds.	Pounds.	Feet.	Feet.	Feet.	Feet.
4	24·25	1631	1450	1332	1197
6	24·25	1963	1702	1596	1465

A comparison of these results shows that 4 pounds of powder give to a ball without windage nearly as great a velocity as is given by 6 lbs. to a ball having 0·14 inch windage, which is the true windage of a 24-pound ball; or, in other words, this windage causes a loss of nearly *one-third* of the force of the charge.

Table showing the loss of Force by the Vent of a Gun.

24-POUNDER GUN.

Powder.	Vent.	Veloc. of ball.	Powder.	Vent.	Veloc. of ball.
Pounds.	Inches.	Feet.	Pounds.	Inches.	Feet.
3	·175	1251	6	closed.	1705
3	closed.	1259	6	·25	1625
6	·25	1696	6	·175	1627
6	·175	1702	6	closed.	1612

These experiments show that the loss of force, by the escape of gas from the vent, is altogether inconsiderable, when compared with the whole force of the charge.

Table showing the Effect of different Descriptions of Wadding.

Powder.		Kind of wad.	Velocity per second.
Kind.	Weight.		
	Grains.		Feet.
G 2	77	Ball wrapped in the cartridge paper, the whole crumpled into a wad and inserted over the p'dr.	1308 1377
"	77	1 felt wad on powder and 1 on ball, . .	1346
"	77	2 felt wads on powder and 1 on ball, . .	1482
French sporting,	77·17	1 elastic wad on powder and 1 on ball, . .	1096 1169
"	77·17	2 pasteboard wads on powder, . . .	1200
"	77·17	2 felt wads on powder, ...	1088
G 6	77·17	2 elastic wads on powder, . . .	1100 1079
"	77·17	2 pasteboard wads on powder, . . .	1193
"	77·17	2 felt wads on powder, ...	1106
"	77·17	2 felt wads on powder and 1 on ball, . .	1190
"	77·17	Ball wrapped in the cartridge paper, as in the first experiment, ...	1237

The *felt wads* were cut from the body of a hat, weight 3 grains.

The *pasteboard wads* were $\frac{1}{10}$-th of an inch thick, weight 8 grains.

The *cartridge paper* was 3 × 4·5 inches, weight 12·82 grains.

The *elastic wads* were "Baldwin's indented," a little more than $\frac{1}{10}$-th of an inch thick, weight 5·127 grains.

The most advantageous wads are those made of thick pasteboard, or of the ordinary cartridge paper.

Comparison of the Force of a Charge in various Arms, as determined by Experiments in Small Arms of Rifle Calibre.

Kind of Arm.	Lock.	Powder. A 5.	Windage.	Ball's Weight.	Velocity.
		Grains.	Inches.	Grains.	Feet.
Common rifle, ...	Percussion.	100	·015	219	2018
" "	"	70	·015	219	1755
* Hall's rifle, ...	Flint.	70	·000	219	1490
* Hall's carbine, ...	Percussion.	70	·000	219	1240
* Jenks's carbine, ...	"	70	·000	219	1687
Cadet's musket, ...	Flint.	70	·045	219	1690
Pistol, ...	Percussion.	35	·015	218·5	947

* Loaded at the breach.

Practical Deductions of Captain Mordecai, suggested by his Experiments.

Proof of Powder.—The common eprouvettes are of no value as instruments for determining the relative force of different kinds of gunpowder.

In the proof of gunpowder a cannon pendulum should be used.

In a 24-pounder gun, new cannon powder should give, with a charge of 6lbs., an initial velocity of not less than 1600 feet to a ball of medium weight and windage.

For the proof of powder for small arms, a small ballistic pendulum is best adapted.

The initial velocity of a musket ball (18 to the pound), of 0·05 inches windage, with a charge of 120 grains, should be:

With new musket powder, not less than 1500 feet.
With new rifle powder, not less than 1600 feet.
With fine sporting powder, not less than 1800 feet.

Manufacture of Powder.—The powder of greatest force, whether for cannon or small arms, is produced by incorporation in the "cylinder mills."

Effect of Wads.—In the service of *cannon*, heavy wads over the ball are in all respects injurious.

For the purpose of retaining the ball in its place, light *grommets* should be used.

On the other hand, it is of great importance, and especially so in the use of small arms, that there should be a good wad over the powder for developing the full force of the charge, unless, as in the rifle, the ball has but very little windage.

Effect of the Size of the Grain.—Within the limits of the difference in the size of grain, which occurs in ordinary cannon powder, the granulation appears to exercise but little influence on the force of it, unless the grain be exceedingly dense and hard.

Effect of Glazing.—Glazing is favorable to the production of the greatest force, and to the quick combustion of the grains, by affording a rapid transmission of the flame through the mass of the powder.

Effect of Using Percussion Primers.—The increase of force by the use of primers, *which nearly closes the vent*, is constant and appreciable in amount, yet not of sufficient value to authorize a reduction of the charge.

Bore, Weight of Charges, and Ranges for U. S. Small Arms.

Kind of arm.	Bore.	Windage of ball.	Powder.	Ball.
	Inches.	Inches.	Grains.	
Musket, . .	·69	*·05	120	397·5 grains. Wad, 10·2 grs.
" . .	·69	†·04	110	410·2 " " 10·2 "
Rifle, . .	·54	·525	75	218·5 " " 8·4 "
Pistol, . .	·54	·525	35	218·5 " " 5·5 "
" . .	·54	·525	30	218·5 " " 5·5 "

* 0·05679 lbs., or 18 to the pound.

† 0·05861 lbs., or 17 to the pound.

Range for Small Arms.

Musket.—With the ball of 17 to the pound, and a charge of 110 grains of powder, &c., an elevation of 36′ is required for a range of 200 yards; and for a range of 500 yards, an elevation of 30° 30′ is necessary, and at this distance the ball will pass through a pine board 1 inch in thickness.

Rifle.—With the charge of 70 grains, an effective range of from 300 to 350 is obtained; but as 75 grains can be used without *stripping* the ball, it is deemed better to use it, to allow for accidental loss, deterioration of powder, &c.

Pistol.—With the charge of 30 grains, the ball is projected through a pine board 1 inch thick at a distance of 80 yards.

Proof of Powder.

Ordinary Proof of Powder.—One oz. with a 24 lb. ball. The mean range of new, proved at any one time, must not be less than 250 yards; but none ranging below 225 yards is received.

Powder in magazines that does not range over 180 yards is considered unserviceable.

Good powder averages from 280 to 300 yards; *small grain*, from 300 to 320 yards.

Dimensions of Powder Barrels.

Whole length, ...	20·5 inches.
Length, interior in the clear, . . .	18· "
Interior diameter at the head, . . .	14· "
" " bilge, . . .	16· "
Thickness of staves and heads, . .	·5 "
Weight of barrels about	25 lbs.

LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

Supreme Court of the United States.

Lead Pipe Case.

Thomas Otis Le Roy & David Smith, *Plffs. in er.* *vs.* Benjamin Tatham, Jr., George N. Tatham, and Henry B. Tatham.	*In error to the Circuit Court of the United States for the Southern district of New York.*

Opinion of Justice Nelson.

The patent in this case, according to the general description given by the patentees, is, for improvements upon, and additions to the machinery or apparatus of Thomas Burr for manufacturing pipes and tubes from metallic substances. They declare, that the nature of their invention and the manner in which the same is to operate, are particularly described and set forth in their specification. In that, they refer to the patent of Burr of the 11th of April, 1820, for making lead pipe out of set or solid lead by means of great pressure, the product being wrought pipe, as contradistinguished from cast or pipe made according to the draw-bench system. The apparatus, as described by Burr, consisted of a strong iron cylinder, bored sufficiently true for a piston to traverse easily within it. This cylinder was closed at one end by the piston, and also closed at the other except a small aperture for the die which formed the external diameter of the pipe. The core or mandril, which determined the inner diameter, was a long cylindrical rod of steel, one end of which was attached to the face of the piston, extending through the centre of the cylinder, and passing also through the centre of the die at the opposite end, leaving a space around the core and between it and the die for the formation of the pipe. The metal to form the pipe was admitted into the cylinder in a fluid state, and when it becomes set or solid, the power of a hydraulic press was applied to the head of the piston, which moving against the body of solid lead in the cylinder drove it through the die, the long core advancing with the piston and with the body of lead through the die, and thus forming the pipe. The cylinder usually holds from three to four hundred pounds of lead, and continuous pipe is made till the whole charge is driven out.

This plan, though one of deserved merit, and of great originality, failed, when reduced to practice, except for the purpose of making very large pipe, larger than that usually in demand, and consequently passed out of general use. The long core attached to the face of the piston advancing with it in the solid lead under the great pressure required, was liable to warp and twist out of a straight line, and out of centre in the die, which had the effect to destroy the uniformity of the thickness and centrality of the bore of the pipe.

The old mode therefore of making pipe by the draw-bench system continued down to 1837, when the patentees in this case discovered by experiment that lead when recently set and solid, but still under heat and extreme pressure in a close vessel, would reunite after a separation of its parts, and "heal (in the language of the patentees) as it were by the first intention," as completely as though it had not been divided.

Upon the discovery of this property of lead, which had never before been known, but on the contrary, had been supposed and believed by all men of science skilled in metals, to be impossible, the patentees made an alteration in the apparatus of Burr founded upon this new property discovered in the metal, and succeeded completely in making wrought pipe out of solid lead by means of the hydraulic pressure. The product was so much superior in quality to that made according to the old mode, that it immediately wholly superseded it in the market. The pipe was also made much cheaper.

The patentees by their discovery were enabled to dispense with the long core of Burr, and to fix firmly a bridge or cross bars at the end of the cylinder near the die, to which bridge they fastened a short core extending into and through the die. By this arrangement they obtained a firm, immovable core, that always preserved its centrality with the die, and secured the manufacture of pipe of uniformity of thickness of wall and accuracy of bore of any dimension. The lead after being admitted into the cylinder in a fluid state, was allowed to remain till it became solid, and was then driven by the piston through the apertures in the bridge into the chamber between it and the die, where the parts reunited after the separation as completely as before, and passing out at the die around the fixed short core, formed perfect pipe.

The patentees state, that they do not intend to confine themselves to the arrangement of the apparatus thus particularly specified, and point out several other modes by which the same result may be produced, all of which variations would readily suggest themselves, as they observe, to any practical engineer without departing from the substantial originality of the invention, the remarkable feature of which, they say, is, that lead when in a set state, being yet under heat, can be made by extreme pressure to re-unite perfectly around a core after separation, and thus be formed into strong pipes or tubes. Pipes thus made are found to possess great solidity and unusual strength, and a fine uniformity, such as had never before been obtained by any other mode. The essential difference in its character, and which distinguishes it from all other theretofore known, they add, is that it is wrought under heat by pressure and constriction from set or solid metal.

They do not claim as their invention or improvement any of the parts of the machinery, independently of the arrangement and combination set forth.

"What we claim as our invention, they say, is, the combination of the following parts above described, to wit: the core and bridge or guide piece, with the cylinder, the piston, the chamber, and die, *when used to form pipes of metal under heat and pressure in the manner set forth, or in any other manner substantially the same.*"

It is supposed that the patentees claim as the novelty of their invention the arrangement and combination of the machinery, which they have described, disconnected from the employment of the new property of lead which they have discovered, and by the practical application and use of which they have succeeded in producing the new manufacture. And the general title or description of their invention given in the body of the letters patent is referred to as evidence of such claim. But every patent, whatever may be the general heading or title by which the invention is designated, refers to the specification annexed for a more particular description; and, hence, this court has heretofore determined that the specification constitutes a part of the patent, and that they must be construed together when seeking to ascertain the discovery claimed. (6 How. 437, Hogg et al. vs. Emerson.)

The same rule of construction was applied by the court of exchequer in England in the case of Neilson's patent for the hot air blast. (Webster's Cases 373.)

Now, on looking into the specification, we see, that the leading feature of the invention consists in the discovery of a new property in the article of lead, and in the employment and adaptation of it by means of the machinery described to the production of a new article, wrought pipe, never before successfully made. Without the discovery of this new property in the metal, the machinery or apparatus would be useless, and not the subject of a patent. It is in connexion with this property, and the embodyment and adaptation of it to practical use, that the machinery is described, and the arrangement claimed. The discovery of this new element or property led naturally to the apparatus by which a new and most useful result is produced. The apparatus was but incidental, and subsidiary to the new and leading idea of the invention. And hence, the patentees set forth, as the leading feature of it, the discovery, that lead in a solid state, but under heat and extreme pressure in a close vessel, will re-unite after separation of its parts as completely as though it had never been separated. It required very little ingenuity, after the experiments in a close vessel, by which this new property of the metal was first developed, to construct the necessary machinery for the formation of pipe. The apparatus essential to develope this property would, at once, suggest the material parts, especially in the state of the art at the time. Any skilful mechanic with Burr's machine before him would readily construct the requisite machinery.

The patentees, therefore, after describing their discovery of this property of lead, and the apparatus by means of which they apply the metal to the manufacture of pipe, claim the combination of the machinery only, when used to form pipes under heat and pressure in the manner set forth or in any other manner substantially the same. They do not claim it as new separately, or when used for any other purpose, or in any other way, but claim it only, when applied for the purpose, and in the way pointed out in the specification. The combination as machinery, may be old; may have been long used; of itself, what no one could claim as his invention, and may not be the subject of a patent. What is claimed is that it never had been before applied or used in the way, and for the purpose they have used and applied it, namely, in the embodyment and adaptation of a newly discovered property in lead by means of which they are enabled to produce a new manufacture—wrought pipe out of a mass of solid lead. Burr had attempted it, but failed. These patentees, after the lapse of seventeen years, having discovered this new property in the metal, succeeded by the use and employment of it, and since then, none other than wrought lead pipe made out of solid lead, has been found in the market, having superseded, on account of its superior quality and cheapness, all other modes of manufacture.

Now, the construction which, I understand, a majority of my brethren are inclined to give to this patent, namely, that the patentees claim as the originality of their invention, simply, the combination of the machinery employed, with great deference, seems to me contrary to the fair and reasonable import of the language of the specification, and, also, of the summary of the claim. The tendency of modern decisions is to construe specifications benignly, and to look through mere forms of expression, often inartificially used, to the substance, and to maintain the right of the patentee to the thing really invented, if ascertainable upon a liberal consideration of the language of the specification when taken together. For this purpose phrases standing alone are not to be singled out, but the whole are to be taken in connexion. (1 Sumn. 482, 485.)

Baron Parke observed, in delivering the opinion of the court in Neilson's patent, "that half a century ago, or even less, within fifteen or twenty years, there seems to have been very much a practice with both judges and juries to destroy the patent right, even of beneficial patents, by exercising great astuteness in taking objections, either as to the title ot the patent, but more particularly as to the specification, and many valuable patent rights have been destroyed in consequence of the objections so taken. Within the last ten years or more, the courts have not been so strict in taking objections to the specifications, and they have endeavored to hold a fair hand between the patentee and the public, willing to give the patentee the reward of his patent."

Construing the patent before us in this spirit, I cannot but think, that the thing really discovered, and intended to be described, and claimed by these patentees, cannot well be mistaken. That they did not suppose the novelty of their invention consisted, simply, in the arrangement of the machinery described is manifest. They state distinctly that the leading feature of their discovery consisted of this new property of lead, and some of its alloys—this, they say, is the remarkable feature of their invention—and the apparatus described is regarded by them as subordinate, and as important, only, as enabling them to give practical effect to this newly discovered property by means of which they produce the new manufacture. If they have failed to describe and claim this as belonging to their invention, it is manifest, upon the face of their specification, that they have failed to employ the proper words to describe and claim what they intended, and that the very case is presented, in which, if the court, in the language of Baron Parke, will endeavor to hold a fair hand between the patentee and the public, it will look through the forms of expression used, and discover, if it can, the thing really invented. Applying to the specification this rule of construction, and all difficulty, at once, disappears. The thing invented and intended to be claimed is too apparent to be mistaken.

The patentees have certainly been unfortunate in the language of the specification, if upon a fair and liberal interpretation, they have claimed only the simple apparatus employed; when, they have not only set forth the discovery of this property in the metal as the great feature of their invention, but, as is manifest, without it the apparatus would have been useless. Strike out this new property from their description, and from their claim, and nothing valuable is left. All the rest would be worthless. This lies at the foundation upon which the great merit of the invention rests, and without a knowledge of which the new manufacture could not have been produced; and, for aught we know, the world have been deprived of it down to this day.

If the patentees had claimed the combination of the core and bridge or guide piece with the cylinder, the chambers, and the die, and stopped there, I admit, the construction now adopted by a majority of my brethren, could not be denied; although, even then, it would be obvious from an examination of the specification as a whole, that the draftsmen had mistaken the thing really invented, and substituted in its place matters simply incidental, and of comparative insignificance. But the language of the claim does not stop here. The combination of these parts are claimed, only, when used to form pipes of lead under heat and pressure in the manner set forth—that is, when used for the embodyment and adaptation of this new property in the metal for making wrought pipe out of a solid mass of lead. This guarded limitation of the use excludes the idea of a claim to the combination for any other, and ties it down to the instance, when the use incorporates within it the new idea or element which gives to it its value; and, by means of which, the new manufacture is produced. How, then, can it be consistently held, that here is a simple claim to the machinery, and nothing more, when a reasonable interpretation of the words not only necessarily excludes any such claim, but in express terms sets forth a different one—one not only different in the conception of the invention, but, different in the practical working of the apparatus to accomplish the purpose intended.

I conclude, therefore, that the claim in this case, is not simply for the apparatus employed by the patentees, but for the embodyment or employment of the newly discovered property of the metal, and the practical adaptation of it by these means to the production of a new result, namely, the manufacture of wrought pipe out of solid lead.

Then, is this the proper subject matter of a patent?

This question was first largely discussed by counsel and court in the celebrated case of Boulton vs. Bull, (2 Hen. Bl., 463,) involving the validity of Watt's patent, which was for "a new invented method for lessening the consumption of fuel and steam in fire engines." This was effected by enclosing the steam vessel or cylinder with wood, or other material, which preserved the heat in the steam vessel: and by condensing the steam in separate vessels. It was admitted, on the argument, that there was no new mechanical construction invented by Watt, and the validity of the patent was placed on the ground that it was for well known principles practically applied, producing a new and useful result. On the other hand, it was conceded, that the application of the principles in the manner described was new, and produced the result claimed; but it was denied that this constituted the subject matter of a patent. Heath and Buller, justices, agreed with counsel for the defendant. But Lord Chief Justice Eyre laid down the true doctrine, and which, I think, will be seen to be the admitted doctrine of the courts of England at this day. "Undoubtedly, he observed, there can be no patent for a mere principle; but for a principle so far embodied and connected with corporeal substances as to be in a condition to act, and to produce effects in any art, trade, mystery, or manual occupation, I think, there may be a patent. Now this, he continues, is, in my judgment, the thing for which the patent stated in the case was granted, and this is what the specification describes, though it miscalls it a principle. It is not that the patentee conceived an abstract notion that the consumption of steam in fire engines may be lessened, but he has discovered a practical manner of doing it; and for that practical manner of doing it he has taken this patent. Surely, he observes, "this is a very different thing from taking a patent for a principle." The apparatus, as we have said, was not new. "There is no new mechanical construction," said the counsel for the patentee, "invented by Watt capable of being the subject of a distinct specification; but his discovery was of a principle, the method of applying which is clearly set forth." Chief Justice Eyre admitted that the means used were not new, and that if the patent had been taken out for the mechanism used, it must fail.

He observed, "when the effect produced is some new substance or composition of things, it should seem that the privilege of the sole working or making ought to be for such new substances or composition without regard to the mechanism or process by which it has been produced, which, though perhaps also new, will be only useful as producing the new substances." Again, "when the effect produced is no new substance, or composition of things, the patent can only be for the mechanism, if new mechanism is used; or for the process, if it be a new method of operating, with or without old mechanism, by which the effect is produced." And again, he observes, "if we wanted an illustration of the possible merit of a new method of operating with old machinery, we might look to the identical case before the court."—p. 496, 493, 495.

This doctrine, in expounding the law of patents, was announced in 1795, and the subsequent adoption of it by the English courts, shows that Chief Justice Eyre was considerably in advance of his associates upon this branch of the law. He had got rid, at an early day, of the prejudice against patents so feelingly referred to by Baron Parke in Neilson vs. Harford, and comprehended the great advantages to his country if properly encouraged. He observed, in another part of his opinion, that "the advantages to the public from improvements of this kind are beyond all calculation important to a commercial country, and the ingenuity of artists who turn their thoughts towards such improvements is, in itself, deserving of encouragement."

This doctrine was recognised by the Court of King's Bench in the King vs. Wheeler. (2 B and Ald. 340. 350.)

It is there observed, that the word "manufactures" in the patent act may be extended to a mere process to be carried on by known implements or elements, acting upon known substances, and ultimately producing some other known substance, but producing it in a cheaper or more expeditious manner, or of a better or more useful kind.

Now, if this process to be carried on by known implements acting upon known substances, and ultimately producing some other known substance of a better kind, is patentable, a fortiori, will it be patentable, if it ultimately produces not some other known substance, but an entirely new and useful substance?

In Forsyth's patent, which consists of the application and use of detonating powder as priming for the discharge of fire arms, it was held that whatever might be the construction of the lock or contrivance by which the powder was to be discharged, the use of the detonating mixture as priming, which article of itself was not new, was an infringement. (Webster Pt. Cas. 94, 97, (n). Curtis on pt. 230.

This case is founded upon a doctrine which has been recognised in several subsequent cases in England, namely, that where a person discovers a principle or property of nature, or where he conceives of a new application of a well known principle or property of nature, and also, of some mode of carrying it out into practice, so as to produce or attain a new and useful effect or result, he is entitled to protection against all other modes of carrying the same principle or property into practice for obtaining the same effect or result.

The novelty of the conception consists in the discovery and application in the one case, and of the application in the other, by which a new product in the arts or manufactures is the effect; and the question in case of an infringement, is, as to the substantial identity of the principle or property; and of the application of the same, and consequently the means or machinery made use of, material only so far as they affect the identity of the application.

In the case of Jupes patent for "an improved expanding table," Baron Alderson observed, speaking of this doctrine, "you can not take out a patent for a principle; you may take out a patent for a principle coupled with the mode of carrying the principle into effect. But then, you must start with having invented some mode of carrying the principle into effect; if you have done that, then you are entitled to protect yourself from all other modes of carrying the same principle into effect, that being treated by the jury as piracy of your original invention." (Webster's pt. cases, 147.) The same doctrine was maintained also in the case of Neilson's patent for the hot air blast in the K. B. and Exchequer in England. (Webster's pt. cases, 342, 371.) Curtis §74, 148, 232. Webster's pt. cases 310.

This patent came also before the Court of Sessions in Scotland, and in submitting the case to the jury the Lord Justice remarked, "that the main merit, the most important part of the invention, may consist in the conception of the original idea—in the discovery of the principle in science, or of the law of nature, stated in the patent; and little or no pains may have been taken in working out the best mode of the application of the principle to the purpose set forth in the patent. But still, if the principle is stated to be applicable to any special purpose, so as to produce any result previously unknown, in the way and for the objects described, the patent is good. It is no longer an abstract principle. It becomes to be a principle turned to account, to a practical object, and applied to a special result. It becomes, then, not an abstract principle which means a principle considered apart from any special purpose or practical operation, but the discovery and statement of a principle for a special purpose, that is, a practical invention, a mode of carrying a principle into effect. That such is the law, he observes, if a well known principle is applied for the first time to produce a practical result for a special purpose, has never been disputed, and it would be very strange and unjust to refuse the same legal effect when the inventor has the additional merit of discovering the principle, as well as its application to a practical object.

Then he observes, again, is it an objection to the patent that in its application of a new principle to a certain specified result, it includes every variety of mode of applying the principle according to the general statement of the object and benefit to be attained? This, he observes, is a question of law, and I must tell you distinctly, that this generality of claim, that is, for all modes of applying the principle to the purpose specified, according to, or within a general statement of the object to be attained, and of the use to be made of the agent to be so applied, is no objection to the patent. The application or use of the agent for the purpose specified, may be carried out in a great variety of ways, only shows the beauty and simplicity, and comprehensiveness of the invention.

This case was carried up to the House of Lords on exceptions to the charge, and among others, to this part of it, which was the sixth exception, and is as follows: "In so far as he (the judge) did not direct the jury, that on the construction of the patent and specification, the patentee cannot claim or maintain that this patent is one which applies to all the varieties in the apparatus which may be employed in heating air while under blast; but was limited to the particular described in the specification." And although the judgment of the court was reversed in the House of Lords on the eleventh exception, it was expressly affirmed as respects this one. Lord Campbell at first doubted, but after the decision of the courts in England on this patent he admitted the instruction was right. (Webster, pt. cases, 683, 684, 698, 717.)

I shall not pursue a reference to the authorities on this subject any further. The settled doctrine to be deduced from them, I think, is, that a person having discovered the application for the first time of a well known law of nature, or well known property of matter, by means of which a new result in the arts or in manufactures is produced, and has pointed out a mode by which it is produced, is entitled to a patent; and, if he has not tied himself down in the specification to the particular mode described, he is entitled to be protected against all modes by which the same result is produced, by an application of the same law of nature or property of matter. And, a fortiori, if he has discovered the law of nature or property of matter, and applied it, is he entitled to the patent, and aforesaid protection.

And why should not this be the law? The original conception—the novel idea in the one case, is the new application of the principle or property of matter, and the new product in the arts or manufactures—in the other, in the discovery of the principle or property, and application, with like result. The mode or means are but incidental, and flowing naturally from the original conception; and hence of inconsiderable merit. But, it is said, this is patenting a principle or element of nature. The authorities to which I have referred, answer the objection. It was answered by Chief Justice Eyre in case of Watt's patent in 1795, fifty-seven years ago; and more recently in still more explicit and authoritative terms. And what if the principle is incorporated in the invention and the inventor protected in the enjoyment for the fourteen years. He is protected only in the enjoyment of the application for the special purpose and object to which it has been newly applied by his genius and skill. For every other purpose and end, the principle is free for all mankind to use. And, where it has been discovered as well as applied to this one purpose, and open to the world as to every other, the ground of complaint is certainly not very obvious. Undoubtedly, within the range of the purpose and object for which the principle has been for the first time applied, piracies are interfered with during the fourteen years. But any body may take it up and give to it any other application to the enlargement of the arts and of manufactures, without restriction. He is only debarred from the use of the new application for the limited time, which the genius of others has already invented and put into successful practice. The protection does not go beyond the thing which, for the first time, has been discovered and brought into practical use; and is no broader than that extended to every other discoverer or inventor of a new art or manufacture.

I own, I am incapable of comprehending the detriment to the improvements in the country that may flow from this sort of protection to inventors.

To hold, in the case of inventions of this character, that novelty must consist of the mode or means of the new application producing the new result, would be holding against the facts of the case, as no one can but see, that the original conception reaches far beyond these. It would be mistaking the skill of the mechanic for the genius of the inventor.

Upon this doctrine some of the most brilliant and useful inventions of the day by men justly regarded as public benefactors, and whose names reflect honor upon their country—the successful application of steam power to the propulsion of vessels and railroad cars—the application of the electric current for the instant communication of intelligence from one extremity of country to the other—and the more recent, but, equally brilliant conception, the propulsion of vessels by the application of the expansibility of heated air, the air supplied from the atmosphere that surrounds them. It would be found, on consulting the system of laws established for their encouragement and protection, that the world had altogether mistaken the merit of their discovery; that, instead of the originality and brilliancy of the conception that had been unwittingly attributed to them, the whole of it consisted of some simple mechanical contrivances which a mechanician of ordinary skill could readily have devised. Even Franklin, if he had turned the lightning to account, in order to protect himself from piracies, must have patented the kite, and the thread, and the key, as his great original conception, which gave him a name throughout Europe as well as at home, for bringing down this element from the heavens, and subjecting it to the service of man. And, if these simple contrivances taken together, and disconnected from the control and use of the element by which the new application and new and useful result may have been produced, happen to be old and well known, his patent would be void; or, if some follower in the track of genius, with just intellect enough to make a different mechanical device or contrivance, for the same control and application of the element, and produce the same result, he would, under this view of the patent law, entitle himself to the full enjoyment of the fruits of Franklin's discovery.

If I rightly comprehend the ground upon which a majority of my brethren have placed the decision, they do not intend to controvert so much the doctrine which I have endeavored to maintain, and which, I think, rests upon settled authority, as the application of it to the particular case. They suppose that the patentees have claimed only the combination of the different parts of the machinery described in their specification, and, therefore, are tied down to the maintenance of that as the novelty of their invention. I have endeavored to show, that this is a mistaken interpretation; and, that they claim the combination, only, when used to embody and give a practical application to the newly discovered property in the lead by means of which a new manufacture is produced, namely, wrought pipe out of a solid mass of lead; which, it is conceded, was never before successfully accomplished.

For these reasons I am constrained to differ with the judgment they have arrived at, and am in favor of affirming that of the court below.

Note.—Seven Judges sat upon the hearing of this cause. Mr. Justice Curtis did not sit, and there was one vacancy. Three Justices dissented from the opinion of Mr. Justice McLean, as published in the last number, so that his opinion cannot be said to have received the sanction of a majority of the full Court.

MECHANICS, PHYSICS, AND CHEMISTRY.

The U. S. Steamship Saranac. By B. F. Isherwood, Ch. Eng., U. S. N.

Continued from page 269.

Statistics of the Machinery of the Saranac.

		Weight of materials in a finished state.	Finished surfaces.	Days' labor.	Cost.
		Pounds.	Sq. In.	No. days.	$ cts.
Engines and Boiler appurtenances, except smoke chimney, grate bars, and brass in bracing, crow feet, &c.,					
Weight of material in a finished state.					
Cast iron, . . .	234,151 lbs.				
Wrought iron, .	128,949 "				
Copper, . .	20,809 "				
Brass, ...	27,010 "				
Steel, ...	1,563 "				
		412,482			
Finished Surfaces.					
Turning and boring,	434,181 sq. in.				
Planing, . .	145,880 "				
			580,061		
Days' Labor.					
Patterns, ...	1,622 days.				
Laborers, ...	115 "				
Fitters, ...	9,789 "				
				11,526	
Total cost, . . .					102,381·57
Paddle Wheels.					
Weight of materials in a finished state.					
Wrought iron, . .	52,367 lbs.				
		52,367			
Total cost, . . .					5,760·37
Boiler, smoke chimney, grate bars, &c.					
Weight of materials in a finished state.					
Cast iron, ...	15,650 lbs.				
Wrought iron, .	16,905 "				
		32,555			
Total cost, . . .					2,836·10
Carried over,		497,404	580,061	11,526	110,978·04

		Weight of materials in a finished state.	Finished surfaces.	Days' labor.	Cost.
BOILERS.		Pounds	Sq.In.	No. days.	$ cts.
Amount brought over,		497,404	580,061	11,526	110,978·04
Weight of materials in a finished state.					
Copper bolts and plates,	191,074 lbs.				
Brass composition,	16,300 "				
		207,374			
Cost of work on boil.,	$16,241·29				
" copper in "	53,149·90				
" brass in "	5,379·00				
Total cost, . . .					74,770·19
COAL BUNKERS.					
Weight of materials in a finished state.					
Wrought iron, .	43,630 lbs.				
		43,630			
Total cost, . . .					5,017·45
EXTRA PIECES, &c.					
Weight of materials in a finished state.					
Wrought iron, . .	4,257 lbs.				
Cast iron, . . .	18,011 "				
Brass, ...	1,164 "				
Copper, ...	124 "				
Steel, ...	4 "				
		23,560			
Finished Surfaces.					
Turning and boring,	11,961 sq. in.				
Planing, ...	5,554				
			17,515		
Total cost, . . .					2,469·28
LUMBER FOR PATTERNS.					
Pine, ...	15,181 cu. ft.				
Mahogany, ...	538 "				
Total cost, . . .					627·65
Grand totals, . . .		741,413	597,576	11,526	194,862·61

Cost of the Saranac.

Hull, ...	$ 150,149·51
Masts and spars, ...	3,547·57
Boats, ...	3,240·28
Rigging and blocks, ...	11,109·28
Sails, ...	6,295·38
Tanks and casks, ...	1,697·11
Anchors and cables, ...	11,544·10
Furniture, ...	1,917·85
Galley, cooking utensils, &c., ...	2,392·87
Armament, ...	15,737·64
Machinery, (original bills,) $ 194,862·61 Do. (after bills,) 5,849·72	200,712·33
Stores in the various departments, exclusive of coal,	16,766·09
Total, ...	$425,102·82

Armament.—The armament of the *Saranac* consists of two 8-inch guns of 106 cwt. each, mounted forward on pivots; and four 8-inch guns of 55 cwt. each, mounted aft in broadside. The ship's personnel numbers 225 souls.

Cost of Repairs on the Saranac.

Total amount of repairs done on the machinery from April 1st, 1851, to October 1st, 1852,	$37,133·49
Total amount of repairs done on the hull, armament, rigging, spars, boats, &c., &c., from April 1st, 1850, to October 1st, 1852,	38,470·83
Making the aggregate cost of repairs from completion, April 1st, 1850, to last fit out, October 1st, 1852,	75,604·32

Time, 30 months, or at the rate of 7·11 per cent. per ann. on first cost.

Weights of the Saranac.

	Tons of 2210 lbs.
Hull,	1037·0
Masts, spars, and sails,	54·9
Tanks, casks, and water in them,	30·3
Anchors and cables,	57·0
Furniture and officers' stores,	5·1
Stores, provisions, galley wood, &c.,	136·2
Armament,	63·8
Officers and men,	20·0
Steam machinery, including water in boilers,	368·3
Coal in bunkers, &c.,	377·4
Total,	2150·0

Making a load mean draft of 17 feet.

On the Analysis of Cast Iron. By Professors Campbell Morfit and James C. Booth.

(Extract from the Official Report to Captain L. A. B. Walbach, U. S. Ordnance, on Foundry Service, upon the Examination of Gun Metal.)

Continued from page 257.

TIN AND TITANIUM.

The filter, *a*, which was set away in the early stages of the process, contained all the silex and slag, tin and titanium, with some carbon. The slag, silex, and carbon, having been determined in previous essays, it was reserved for the estimation of the two remaining components. A qualitative examination is only necessary generally, for in no one of our samples did we find even traces. Still, they may occasionally exist, and must be sought, and if largely present, separated in the usual manner.

7. *Tin.*—If tin existed in the metal, it was converted into insoluble stannic acid by the oxidizing action of the nitric acid and subsequent evaporation, and remained with the insoluble residue. Its presence is proved by fusing the suspected insoluble residue on charcoal with carbonate of soda, grinding that part of the coal in an agate mortar with water, and washing over with water until all the charcoal and other light particles have been removed, when tin will betray itself by silvery spangles and streaks produced by the pestle.

8. *Titanium.*—The presence of titanium is best shown by fusing the whole residue with carbonate of soda, extracting with luke-warm water, filtering, partially neutralizing, and boiling; titanic acid will precipitate.

A yellowish tint in the soda solution will also indicate the presence of chrome.

ARSENIC, ANTIMONY, AND SULPHUR.

As these components, if present, exist in quantities too minute to be estimated from one gramme of metal, a new portion of five grammes of *clippings* must be treated specially for the purpose.

9. *Arsenic.*—These are placed in a beaker of 16 ounces capacity, and drenched with a fluid ounce of pure nitric acid. The glass is covered with an inverted capsule, and very gradually heated to boiling by a small spirit lamp. As the digestion progresses, 13 to 15 grammes of finely powdered chlorate of potassa are added portionwise, and the heat continued until the insoluble particles become flotant, when the digestion is completed. The nitric acid and chlorate of potassa, having eminent oxidizing powers, convert most of the ingredients wholly into a soluble form. The metals being oxidized, their oxides dissolve in the acid, the sulphur and arsenic have become soluble arseniate and sulphate of potassa, and carbon, silex, and slag remain as insoluble residue. The liquor is evaporated to dryness to render silica insoluble, re-digested in hydrochloric acid to remove oxide of iron, &c., diluted with water, filtered, and hot-washed. The filter is rejected, its contents having been already estimated in previous essays. The filtrate is G.

Aqua regia cannot be substituted for the mixture of nitric acid and chlorate of potassa, for the amounts of sulphur and arsenic are so small that portions may be volatilized as gaseous hydrogen compounds. Nitric acid alone is slow in action, and the addition of *fuming* nitric acid to hasten its action, might introduce the very substances it is desired to detect, for that reagent is seldom pure.

If the size and distinctness of the tache formed upon the porcelain in the qualitative essay indicated an appreciable quantity of arsenic, the process must be continued as follows, to separate and estimate it quantitatively.

The filtrate G contains all the ingredients in soluble form, except those separated by the filter, but owing to a large excess of potassa salt, which is difficultly removed, is valuable only for the sulphur and arsenic.

It is difficult to estimate arsenic quantitatively by that modification of Marsh's process, by which the arseniuretted hydrogen is reduced by heating the middle of the exit tube, for a portion of it may escape decomposition, and the black ring of arsenic obtained in the tube beyond the heated part will only represent a fraction of it. It is true, that Lassaigne's improvement, to conduct the excess of gas into a solution of nitrate of silver, recovers the whole of the arsenic, but we believe that a modification of Reinsch's is a more effectual plan.

Strips of planished copper are introduced into the heated filtrate G, until a fresh surface ceases to be tarnished. The strips are then removed, rinsed in distilled water, and, when dried, carefully laid upon a sheet of glazed paper, and the tarnished coating entirely scraped off with a knife. The scrapings, carefully collected, are introduced into a long and narrow glass tube, and heated to sublime the arsenic as arsenious acid. The upper part of the tube, containing the sublimate, is then cut off, and with its contents accurately weighed. The arsenious acid having been removed by hydrochloric acid and water, the empty tube is dried, and again weighed. The difference in weight expresses the amount of arsenious acid in the filtrate, whence the metallic arsenic is calculated. A more critically accurate method would be to dissolve the scrapings in nitromuriatic acid, and to estimate the arsenic acid from the filtered solution by a given weight of metallic iron, as directed for phospborus.

10. *Antimony.*—The only two substances in cast iron precipitated by the metallic copper are arsenic and antimony, and as the two are frequently associated, and give similar metallic stains, we thought it advisable in estimating one to test for the presence of the other. This was done by adding to the tache on the china a concentrated solution of iodate of potassa, which, according to Slater, (*Chem. Gaz.*, ix. 57,) reddens and immediately dissolves arsenical stains; while upon those of antimony it exerts no visible action for several hours. Chlorinated soda or lime will also instantly dissolve arsenic, and leave the antimony.

11. *Sulphur.*—If the tache did not indicate an appreciable quantity of arsenic, the preceding manipulations may be omitted; otherwise, after it has been separated, as above directed, chloride of barium is poured into the residual liquor, the whole stirred, and left to repose for several days. If the content of sulphur is very minute, cloudiness does not manifest itself for several hours, and in such cases a week's repose is necessary to insure the entire subsidence. It must then be filtered off, washed with diluted hydrochloric acid and hot water, ignited, weighed, and the amount of sulphur calculated from the weight of sulphate of baryta.

It is proper to observe, in order to provide against the possibility of error, that some caution is necessary as to the nature of the precipitate; for if the solution be concentrated, a portion of the chloride of barium, which is generally added in excess, may ultimately fall in fine crystalline powder, but it will disappear during washing on the filter. The previous acidulation of the liquid prevents the precipitation of carbonate, phosphate, or arseniate of baryta.

NITROGEN, OXYGEN, AND ARIDIUM.

Nitrogen.—The doubts of many of the best chemists as to the presence of this element in cast iron, having been confirmed by the recent experiments of a careful investigator, we omitted searching for it.

Oxygen.—We doubt the presence of oxygen as an essential ingredient of recently made metal, except in the minute portions of slag accidentally remaining in it, and which sometimes contains a silicate of the oxide of iron.

Aridium.—Aridium, said to have been found in some Swedish ores, was not observed by us in our examination.

August 8, 1852.

ERRATUM.—On page 200, in first column, top line, for "*strong* acid," read "*weak* acid."

For the Journal of the Franklin Institute.

On Kemp's Gas Thermostat. By CHARLES M. WETHERILL, Ph. D., M. D.

Kemp describes in the *Chemical Gazette*, vol. VIII. p. 184, (1850,)* a very convenient apparatus for regulating the heat of a gas burner, which deserves a cordial welcome by chemists who have lost their time, patience, and frequently their analysis, by the use of the air bath described in the works on analysis. A great drawback probably to the introduction of Kemp's thermostat, is the use of a platinum tube, which he was at last obliged to add, after several inefficient attempts to avoid it. To those who have not seen Kemp's description, it may be necessary to state, that it is an air thermometer, placed in the space to be heated, and so regulated by a tube connected with the gas pipes, that the mercury rising to a certain point in the air thermometer, will close the extremity of the said tube, and thus shut off the supply of gas from its burner, which is fed from a tube leading from the upper part of the air thermometer. The tube slides in a brass stuffing box, and when the temperature has reached the required point, (as shown by a thermometer,) it is pushed down to the level of the mercury, so as to shut off the supply of gas. To avoid the light being extinguished, a small hole is bored in the sliding tube, an inch above its extremity. An inspection of the accompanying figures will make this plain. The difficulty Kemp found in employing other tubes than platinum, arose from inefficient contact where no amalgamation ensued, thus suffering the heat to rise "many degrees above the assigned limit;" while copper and brass tubes quickly dissolved in the mercury, rendering it impure, "so that its rise and fall could not be depended upon with the required nicety."

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* See Journ. Frank. Inst., Vol. xx., Third Series, p. 336.

Fig.1.

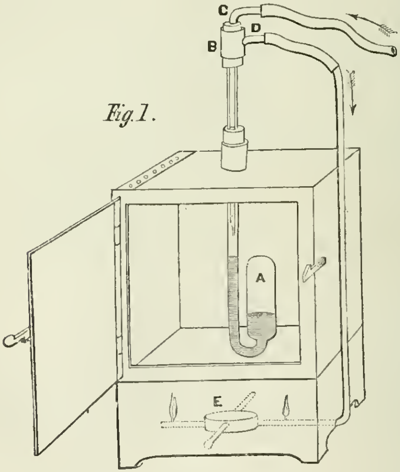
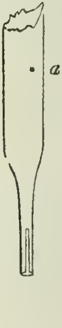


Fig.2



I have found no difficulty in using a glass tube in the place of platinum. Its adaptation depends upon a very simple alteration, namely, of drawing out the extremity. By this means, the extremity of the tube comes in the centre of the rising column of mercury, which closes it accurately. In order to effect this the more surely, the part drawn out is $\frac{1}{16}$-inch diameter, and of the same diameter for about $\frac{3}{4}$-inch. A quarter of an inch from its extremity is broken up carefully with a very fine angular file. It will be scarcely possible, with glass tubes, to make this slit sufficiently fine that the light be shut off gradually, as Mr. Westly proposes, (*Chemical Gazette*, vol. VIII. p. 239;) since the area of opening necessary to heat an air bath of ordinary size is very small; but the mercury reaching the glass for a short distance before closing the aperture, enables a very accurate closure. When the column of mercury in this tube is barely sufficient to stop the supply of gas, it lowers the flame somewhat, and by a very rapid opening and closing of part of the hole, gives rise to a humming noise, thus attracting attention to the apparatus. The supply of gas should be so regulated that only a slight excess be allowed for variations of pressure. The intervals of this tone will thus become longer and longer, and the temperature will remain constant. Of course, a too great supply of gas, causing the mercury to rise several lines above the aperture of the sliding tube, will render the equilibrium which takes place between the area of this aperture and the required temperature an unstable one, and liable to be disturbed by any sudden cooling effect. The above mentioned tone, therefore, is not without its use, in calling attention to the apparatus until it be regulated properly.

I have had two of these apparatus in use for some time. One is placed in the oven under my sand bath, (which is a large one heated by gas burners.) When the sand bath is not in operation, the sinking of the mercury in the air thermometer raises the lights in the oven. This thermostat worked well, and gave a constant temperature, both when the sand bath was used and when it was out of action.

The other is adapted to an air bath. This very convenient form of air bath (fig. 1) is described in all the works of Analysis that I have seen as necessary to be brazed. This is not at all important, and adds considerably to its expense; a few rivets will answer the purpose equally well, and the chemist may make it himself. The top, bottom, and sides are of one piece, riveted together, the edges being turned down behind and before, to rivet in the back and for the door. A represents the air thermometer, which is of glass. It is convenient to add sufficient mercury, that when the temperature inside the bath is at the height at which it is generally used, the mercury column is visible outside the stove. Instead of Kemp's form of stuffing box, B is best made of a piece of brass tube, to which a smaller one, D, is soldered; the sliding tube, C, and the long stem of A are easily adapted by means of perforated corks. The gas enters at C, and finds its way through the open extremity to the long stem of the air thermometer, from which it passes to the burner at D. This burner is conveniently made by brazing two brass tubes in the form of a cross, and so that their bore communicates; the ends being closed, four holes are made with a drill formed from a needle. The dimensions of the burner are such, that each flame is at a distance from the side of the oven equal to a quarter of its linear dimension. This gives great regularity to the heat. A piece of lead, E, cast upon the intersection of the cross, will serve to steady the burner, and to give air to the flame, by permitting the circulation of air from beneath. A box, four inches in height, upon which the oven rests, encloses the flame; in it an opening, with a movable cover, is left, to light the gas and watch the flame when necessary. The top of the oven has an additional opening, for the insertion of a thermometer, to regulate the heat when adjusting the sliding tube.

Fig. 2 represents the end of the sliding tube in its proper size. The hole, *a*, through which the gas passes to the burner when the extremity is closed, must be of such a size that merely enough gas passes to prevent the extinction of the light. It is made by heating the tube by a pointed flame, and touching it with a red-hot platinum wire, by which means a small tube may be drawn out, which when broken leaves a small hole; this hole is then melted together in the flame until after trial in the apparatus it is found small enough.

I found no difficulty in keeping within a degree of the temperature required; of course, the delicacy of the apparatus is in proportion to the difference between the contents of the air receiver and the diameter of the long arm of the air thermometer, and owing to increase of pressure, the higher the mercury in this arm the more slowly will it rise by increase of temperature.

For the Journal of the Franklin Institute.

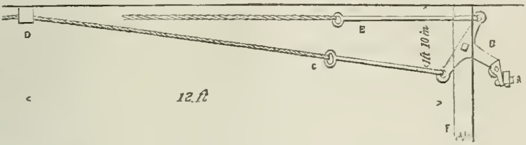
Explosions on board the Steamers Fusileer and Shreveport. By A. C. Jones.

To the Committee on Publications.

Gentlemen:—In the early part of January, an explosion took place on board the Attakapas packet *Fusileer*. It occurred in the Gulf, a short time after leaving the Mississippi river, on her way to Attakapas, and is said to have been caused by gross mismanagement, coupled with drunkenness. The boat was towed to her place of destination, thereby evading an examination into the causes which resulted in the loss of life. This was the first in this vicinity under the new law; and of the second I will now furnish you with the particulars.

The steamer *Shreveport*, on the 20th, in attempting to back out from a landing on Red river, collapsed the inside flue of the larboard boiler, scalding the second engineer and carpenter, who were aft on duty, and injuring a fireman, who was firing at the time.

The boat has a stern wheel, and the engines and "doctor" are consequently near the stern of the boat, leaving about fifty feet space between them and the after ends of the two boilers. The steam gauge, capable of indicating 200 pounds to the square inch, is connected with the steam pipe above where it branches to the engines. There is here also a supplemental screw valve and pipes for blowing off steam from the boilers through the main steam pipe; this valve had been put on the trip before. A small steam drum connects the two boilers at the after end, the safety valve being over the starboard boiler, and the steam pipe over the larboard one. The accompanying sketch gives the contrivance for either raising or holding the end of the safety valve lever down, and is of the roughest description of workmanship. Where it is attached to the end of the safety valve lever, it gives eight leverages, the fixed weight inside of it being 7½ to 1. Cords from each end of the bent lever pass through small holes in three wooden cleats, (out of line with each other sideways,) fastened to the carlins above.



a, end of safety valve lever; *b*, bent lever, each arm is 8½ inches long; c, small rod and cord for holding the lever down; *d*, first wooden cleat; *e*, cord for raising lever; *f*, stanchion through which the bent lever works.

At D, in the sketch, it will be seen that the angle of the cord for holding the lever down is considerable, and yet there is no rounding of the small hole to compensate for this deviation from a straight line; the lines finally pass over two-inch sash pulleys down to the side of the starboard engine. To the end of the cord for holding down the valve, is tied *permanently* the half of a cam, (about 30 lbs.) Now, one pound on the end of this cord, by its zigzag course and swelling by the wet weather, which has prevailed for some time past, and the roughness of all the parts in connexion with it, will give many pounds on the end of the lever; in fact, to all intents and the purposes of a safety valve, making it useless, *the valve being perfectly locked.*

This was the first trip of both engineers on this boat, and they were fully provided with certificates from the inspectors of this place, attesting their competency!

The boat had stopped at a landing over fifteen minutes, and steam had been blown off *only* through the valve mentioned, which is too small for the purpose, as it could not discharge steam as fast as the boilers could make it. *They had stopped blowing for about two minutes*, and before a part of a turn of the wheels was made to back out, the flue collapsed, and most of the water was discharged aft. The boilers have been about four months in use.

On examination, I found the flue to be flattened nearly vertically its whole length, and lying up against the other flue. It is partly torn off from the after wrought iron head; the other end is half torn off in the lap, a quarter sheet in length from the head, which is much "buckled," apparently by the great pressure on its surface.

The flues are fourteen inches in diameter; the iron is *three-sixteenths* of an inch in thickness, and is of a medium quality. There is a two inch water space between the flue and the shell. Each boiler has three gauge cocks, the lowest one being about one inch above the tops of the flues; the water line is well defined, and is above the lower gauge cock. That there was plenty of water at the time, is borne out by the appearance of things around, and by the fact of the men at the engines, fifty feet from the boilers, being scalded, although they were partially protected by a large quantity of freight on the deck.

The true cause was a pressure exceeding the resistance of flues of this diameter, only three-sixteenths of an inch in thickness.

I have before given my opinion of the impropriety of having the water space between the flue and shell so small; and although in this case it was two inches, being more space than a great many boilers in use have, yet the collapsed flue bears evidence of the softening effect, from the great amount of steam bubbles forming on its surface, or the repulsion of the water from this contracted space by the action of the fire on both its sides.

It is said that the inspectors have revoked the certificates of both engineers. This is no more than right; but it is rather late to punish these persons after the injury is done, considering the very loose manner in which "qualified engineers" were made. The inspectors have directed a new flue of the same thickness to be put in; so that it is probable that these boilers may be heard from again.

The new law giving ample power to the inspectors over the details of the boilers, there will be some hope of the removal of the cast iron steam connexion pipes, used on many of the boats of this section, some of which, in addition to the unavoidable settling of the boilers, use these cast iron pipes or steam drums *for the stancheons to set on* for the support of the cabin floor, this part of which is often used for the stowage of the trunks and light freight of the passengers. Several instances have come under my notice of the breaking of these pipes, in which loss of life resulted therefrom.

New Orleans, March 26, 1853.

For the Journal of the Franklin Institute.

Flying—Balloon—Parachutes.

When will the flying of insects and of birds be taken up for investigation by naturalists; or are the mechanisms and actions of their wings—than which no department of natural science offers stronger inducements—to be still thrown aside for the determination of species and genus, and to the accumulation of technical and minute details that have no bearings on truths precious to the engineer. It is marvelous that they have been so long neglected, and the more so, that few zoologists, if any, are yet awake to the fact that the contrivances by which power is conveyed and applied through the organs of motion in animals, involve mechanical novelties and problems in physics of surpassing interest and lasting value. Had they been appreciated, their solution had been attempted ere now. But a spirit of inquiry has arisen, and the demands for practical science have been so urgent, that the laws which govern the flight of birds through the air, and of fishes through water, cannot be much longer neglected. And certainly, on more pleasing and profitable fields of discovery neither the natural nor the mechanical philosopher never entered.

Obvious, palpable, and ever occurring, as are the movements of birds and insects in the atmosphere, there is much in them that is inexplicable; much at all events which I cannot explain; whilst the constant repetition of these movements, their apparent simplicity and their wonderful variety,—every species having paces or flights and manœuvres peculiar to themselves,—give piquancy to one's curiosity. Look at those pigeons as they sweep down to the street, and back again to their cotes on the church roof; don't their wings appear to move far too slow in the thin and yielding medium, to account for the velocity of their bodies through it? To go at the rate they do, every stroke should be as effective as the leap of a kangaroo; but observe, they flap them rather vertically than in the direction of flight; and therein is not the least difficulty to be got over. Some persons may imagine every thing plain and transparent,but I am almost sure they have never given close and prolonged attention to the subject, nor attempted to trace the various movements to their first principles.

Another perplexity is, how the upward strokes do not neutralize the effect of the downward ones, as in the waving of a fan, in which the resistance is the same in both directions. It cannot be that as much power is expended in elevating the wings as in giving effect to their downward strokes, for that would be consuming half the force to no useful purpose, a defect not allowable in artificial machines, and which unquestionably belongs to no natural one. The explanation is far from being obvious. As for the idea that the pinions act as valves, by opening when the wing is rising to let the air through, and closing when its movement is reversed, I have not been able to detect the process in practice, though this may be due to distance and imperfect vision. Still, no such device is essential to flying, since nothing of the kind can take place with bats, butterflies, house flies, flying-fish, and other soarers whose organs of flight are continuous or unbroken sheets. There is no doubt something like a sculling action—a drawing forward of the organs, edgewise, to repeat the strokes; though how even this is done, is not very perceptible. It is supposed, that the slight convexity of the upper surfaces, and corresponding cavity of the under sides, contribute somewhat to the result. Probably they do, but it cannot be much. The downward flaps are, it is believed, not made quicker than the upper. I have often noticed, and not without surprise, old weather-beaten crows passing quickly along, with one or more feathers out of their wings, and the rest more or less jagged and damaged; and have been almost ready to suspect the existence of an unknown element of buoyancy or of progression, or of both, to account for the phenomenon. Be this as it may, there *are* secrets in the flight of birds and insects, and their disclosure will contribute some exquisite additions to mechanical science.

As regards *Ballooning*, an idea that has often thrust itself on my attention is submitted to the consideration of æronauts. It is this:—instead of an immense inflated sphere, or spheroid, adopt two, three, or more cylindrical and *vertical* tubes, long and closed on the upper ends, charge them with hydrogen gas, and connect their lower ends to a light wooden shaft, furnished with a ratchet and a crank or spokes to turn it, *i. e.* to a windlass fixed in the car. By this arrangement, the means of ascending and descending are secured; for by winding up more or less of the tubes on the windlass, their ascensional power would be diminished, the gas being driven by the act of winding into the upper or floating portions:

while by letting out more, the levity of the whole would be increased; although this mode would not facilitate lateral progress, (and lateral progress of balloons by artificial means has not yet been, if it ever be attained, except in still atmosphere,) it gives the æronaut the power of ascending and descending without loading his apparatus with ballast, and that is something, besides enabling him to reduce the dimensions of balloons. The tubes might of course be inclosed in the usual netting, and a single one might be sufficient for connexion with the windlass.

Parachutes.—Cannot these be made to come down uniformly and without violence? Can either form or motion, or both, be given them that will cause them to descend, in a circuitous instead of a direct path, and thereby prolong the time of their descent? These questions are to some extent answered by the following experiment:—Take a slip of letter paper, an inch or an inch and a half long, and $\frac{1}{4}$ or $\frac{3}{8}$ inch wide; let it fall endwise from your fingers, when it will reach the floor at once, and almost in a straight line: but stand on a chair, and let it drop horizontally from near the ceiling, and it will turn rapidly on its longer axis, and will descend to the carpet in a wide spiral of several turns. It will be three, five, or ten times longer in the air than when it falls without turning on its axis. The faster it turns the longer is it detained in the helical orbit of its descent. (To insure its evolution on its axis, a slight twist in opposite directions might be given to the slip; but this is hardly necessary in small pieces.)

Some important truths may receive illustration from this simple experiment, but the question here is, can the principle evolved be applied with advantage to parachutes? I think it can—for if they and more or less of their appendages, be composed of light revolving slats, the result sought for would at least be partially attained. Now there is no great difficulty in substituting such slats for the cloth or silk covering of parachutes, of introducing strings of them between a parachute and its car, and if need be of attaching them to the latter itself; but it is the principle, not details of its application, to which the attention of those who have faith in the navigation of the firmament is invited.

E.

For the Journal of the Franklin Institute.

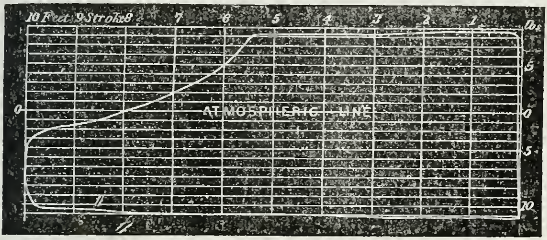
Notes on the U. S. Steamship Powhatan. By B. F. Isherwood, Chief Eng., U. S. Navy.

The following particulars in relation to this vessel will be of interest, in connexion with the article under the same title in the last February No. of this Journal.

Before leaving Norfolk, Va., (after the steaming recorded in the Feb. number,) an alteration was made by the Chief Engineer, Mr. George Sewell, in the arrangement of the valve gear, for the purpose of obtaining better results. The accompanying indicator diagrams were taken as the vessel was bound out, and sent back to me by the Pilot. By comparing them with the indicator diagrams in the February number, a very great improvement will be observed; the exhaust end of the diagram is much squarer, and the condensation reaches its maximum much sooner.

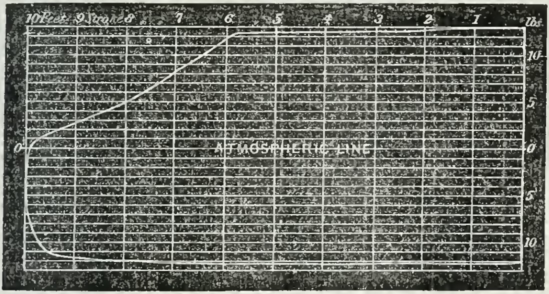
The paddle wheels had been increased 8 inches in diameter, to give them greater dip. Sea smooth, weather calm.

Diagram No. 1.—Revolutions of the wheels, $10\frac{1}{2}$ per minute; steam pressure in boilers above atmosphere per square inch, $10\frac{1}{2}$ lbs.; throttle, $\frac{3}{8}$ths open; back pressure in condensers per gauge per square inch, 2·2 lbs.; temperature of hot well, 98° F.



Port Cylinder, (bottom.)

Diagram No. 2.—Revolutions of the wheels, 11 per minute; steam pressure in boilers above atmosphere per square inch, 15 lbs.; throttle, $\frac{1}{4}$th open; back pressure in condensers per gauge per square inch, 2·2 lbs.; temperature of hot well, 100° F.



Starboard Cylinder, (bottom.)

At my request, the temperature of the smoke chimney was taken; the thermometer was put in a few feet above the top of the steam chimney, and stood with bright fires in the furnace at 452° F. Calculated from this temperature by Buchanan's formula, the velocity of the draft would be 33·54 feet per second. The length of travel of the heated gases from the centre of the furnace to their delivery in the smoke chimney is 39 feet; from which will be perceived how short was the time the heated gases were in contact with the heat-absorbing surfaces. The proportion of the heating (copper) to grate surface was nearly 22 to 1, and seems to have been much too small for the proper reduction of the heat of the gases.

According to the experiments of Professor Walter R. Johnson, one pound of Cumberland bituminous coal requires for its complete combustion the oxygen of 237·31 cubic feet of air, at 60° F. temperature and 30° barometer. From the steam log of the *Powhatan*, it appears that the mean consumption of Cumberland coal for all the steaming done is 3808 pounds per hour, which would require 903,676·48 cubic feet of air, containing 180,735·296 cubic feet of oxygen, weighing 15,023·03 pounds; from this must be deducted the oxygen already in the coal, viz: $9\frac{1}{2}$ per centum of 3808 pounds, or 361·76 pounds; leaving 14,661·27 pounds to be supplied from air. The combustible materials of the coal consist of carbon and hydrogen, in unequal parts, and these elements unite with oxygen in different proportions. The average composition of Cumberland coal may be taken as follows:

Carbon, ...	75·0	per centum.
Hydrogen, ...	4·5	"
Nitrogen, ...	1·5	"
Oxygen, ...	9·5	"
Earthy matter, ...	9·5	"
	100·0	"

Of the above, the carbon and hydrogen only are combustible. As one pound of carbon unites with $2\frac{2}{3}$ pounds of oxygen, and one pound of hydrogen with 8 pounds of oxygen, and as $75 \times 2\frac{2}{3} = 200$, and $4{\cdot}5 \times 8 = 36$, the total weight of oxygen (14,661·27 pounds) required for the combustion of the 3808 pounds of coal, would be disposed of in the proportion of 200 to the carbon and 36 to the hydrogen, or 12,022·24 pounds to the carbon, and 2639·03 pounds to the hydrogen. Now, 75 per centum of 3808 pounds is 2856 pounds, and $4\frac{1}{2}$ per centum of 3808 pounds is 171·36; and 2856 pounds of carbon united with 12,022·24 pounds of oxygen = 14,878·24 pounds of carbonic acid gas, and 171·36 pounds of hydrogen united with 2639·03 pounds of oxygen = 2810·39 pounds of steam.

Of the total products of combustion of the 3808 pounds of coal, there would be—

Uncombined Nitrogen from the air, . .			705,532·50	cubic feet.
Nitrogen in coal, ($1\frac{1}{2}$ per centum,)	57·12	pounds, or	780·51	"
Steam, . . .	2810·39	"	76,177·20	"
Carbonic Acid Gas, . .	14,878·24	"	129,664·53	"
Total, ...			912,154·74	"

The uncombined nitrogen from the air will be the quantity of that element in the amount of air required for the combustion of the coal, less the quantity of nitrogen corresponding to the oxygen in the coal in the proper proportion for forming atmospheric air. Now, in the coal there was 361·76 pounds of oxygen, occupying in the gaseous state 4352·17 cubic feet; the quantity of nitrogen corresponding to this to form atmospheric air would be 17,408·68 cub. ft., which deducted from 722,941·184 cubic feet, ($\frac{4}{5}$ths of 903,676·48) leaves 705,532·50 cubic feet.

Thus the ultimate fact of which we were in search is, that for the complete combustion of 3808 pounds of Cumberland coal, there must pass per hour through the flues of the boiler 912,154·74 cubic feet of gaseous matter at a temperature of 60° F. and barometer 30°. If we consider these gases to have entered the flues at a temperature of 1020 Fah., their bulk will have been increased three-fold, or will have become 2,736,464·22 cubic feet.

Now, the least cross area of the flues is 55,906 square feet, and at a velocity of 33·54 feet per second, or 120,744 feet per hour, there would be passed 4,049,753·76 cubic feet of gaseous matter, or 48 per centum more than required. Hence it appears that, so far from being any deficiency, there must have been a superabundance of oxygen supplied to the furnaces.

*The Magnetism of Torsion.**

We translate the following article from the French scientific journal *L'Institut*, of the 19th instant, on the subject of magnetic currents of induction produced by the torsion of iron. This was a communication from M. Mertheim to the Academy of Sciences at its last sitting, and details the results of his experiments, which will be found to have an important bearing on several mechanical questions:

It has long been known that a thread of iron, submitted to the action of terrestrial magnetism, becomes permanently magnetic when made to undergo a considerable amount of torsion equally permanent. An explanation of this circumstance has been attempted, in saying that the torsion acts in the same manner as every other mechanical disturbance, that it promotes the decomposition of the two magnetic fluids, and that at the same time it gives to the iron a certain coercive force. That opinion rests upon facts imperfectly observed. Torsion acts in a manner quite peculiar, in forcing the metallic molecules to arrange themselves spirally, and in thus giving to matter itself the form which Ampère has assigned to inferior currents. Torsion produces temporary magnetic effects when it is temporary, and permanent effects when it is permanent; and these effects cannot be produced by any other mode of action of mechanical forces.

Temporary Effects.—A bar of iron, magnetized to the point of saturation, becomes partially demagnetized at the moment it experiences a temporary torsion, and remagnetized at the moment of contrary torsion, (*detorsion*), or, in other words, it is traversed by an inverse current during the torsion and by a direct current during the contrary torsion, whatever may be the direction in which this torsion takes place.

We understand by "magnetization to saturation," the state of magnetic equilibrium in which a bar of iron is when it has received all the magnetic excitement it is susceptible of acquiring under the action of a given current, or which, after the interruption of that current, has already lost all which it was unable to keep. So long as that equilibrium is not established, torsion and contrary torsion only act as other mechanical disturbances.

The manner in which the experiment is made is as follows:—A bar of iron, well heated beforehand, 1 metre in length (nearly 40 inches), and 15 millimetres in diameter (nearly six-tenths of an inch), is rigidly fixed at one of its ends, while the other is placed in the centre of a wheel, by means of which torsion in contrary senses can be produced upon it. It has two spirals, of which one is intended to receive the current of a single element of Daniell, while the other serves as a spiral induction. The latter is placed in communication with a galvanometer sensible to the astatic needle. It is unnecessary to observe that the two spirals are sufficiently remote from one another to prevent direct induction.

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* From the London Mechanic's Magazine, December, 1852.

The establishment of the current causes the needle to move through an angle > (greater than) 90° towards the right. The north pole is found to fit into the spiral (*encastré*), and the south pole is twisted. When the current is made to pass in the contrary sense, the south pole of the bar fits in the spiral, the north pole is twisted, and the needle revolves towards the left.

The following table will exhibit at a glance the results of the experiment:

Torsion to the Right.	Contrary Torsion.	Torsion to the Left.	Contrary Torsion.	Observations.
>90 right.	>90 right.	90 right.	70 right.	The bar beomes magnetized. Every other mechanical disturbance acts upon the needle in the same sense as torsion.
50 right.	45 right.	20 right.	35 right.	
3 left.	50 right.	12 left.	45 right.	The bar being magnetized to saturation, the application of any force which does not produce torsion, leaves the needle at 0.
5 left.	35 right.	20 left.	45 right.	
20 left.	30 right.	20 left.	30 right.	
70 left.	60 left.	90 left.	75 left.	The current was reversed, and the result was that the same facts were reproduced, but in a contrary sense.
50 left.	50 left.	5 right.	50 left.	
12 right.	40 left.	14 right.	40 left.	
30 right.	42 left.	30 right.	40 left.	
>90 right.	20 right.	90 right.	10 right.	The current was interrupted. The bar became demagnetized; itself at first at the point of saturation.
50 right.	0	35 right.	15 left.	
20 right.	5 left.	30 right.	15 left.	
20 right.	10 left.	12 right.	10 left.	

The coercive force in every mass of iron may be measured by the number of torsions necessary to make it attain the point of saturation.

Permanent Effects.—When a bar of iron or a bundle of threads, has been magnetized by means of strong permanent torsion under the action, whether of the terrestrial current or of any other, it does not prevent the phenomena of an ordinary magnet. *All torsion—temporary or contrary torsion—which acts upon it in the direction of permanent torsion, produces magnetization, or a direct current; and all torsion, or contrary torsion, which acts in the opposite direction, produces demagnetization, or an inverse current.*

This experiment is easily performed with two bundles of the same iron thread, suspended vertically, and twisted so as to make of the one a helix *dextrorsum*, and of the other a helix *sinistrorsum*. They both have their north poles above, and their south poles below, and upon their being introduced into the spiral, the needle is moved towards the right. But after having placed the north pole of each bundle in the spiral, if temporary torsions be given to the south pole, it will be found that a torsion in the same direction will produce contrary currents, according as it is applied to the one or to the other of the two bundles.

The following results are obtained:

	Torsion to the Right.	Contrary Torsion.	Torsion. to the left.	Contrary Torsion.
For the *dextrorsum* bundle, which was first twisted from right to left.	15 left.	10 right.	15 right.	14 left.
For the *sinistrorsum* bundle.	15 right.	15 left.	15 left.	15 right.

It is only necessary, therefore, to add to the apparatus a commutator, to reverse the direction of the current after each semi-oscillation, in order to obtain, by means of the turning vibrations, a continuous current which may be rendered highly intense.

These facts appear to me (M. Wertheim) likely to raise theoretical questions of extreme importance. I propose to discuss them in a work on the torsion of solid bodies in general, upon which I have been long occupied.

For the Journal of the Franklin Institute.

Have we a New Power?

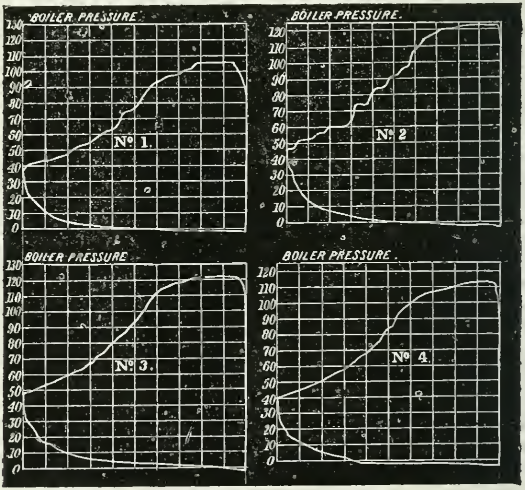
The caloric ship Ericsson has since her trial early in January, made a trip to Washington for the purpose of demonstrating her success, and also of obtaining for Capt. Ericsson a contract from the government for one or more first class war vessels. Unfortunately for the community, (and also I think, for those who have invested their money in the enterprise,) no disinterested persons competent to judge were allowed on board, and to form an opinion from the reports of Capt. Ericsson or Capt. Sands, would be unfair; for the former is so deeply interested in the enterprise as almost to form a part of it, while the latter is unacquainted with machinery, and has given much of his testimony on hearsay evidence; there was no one on board to note the revolutions, weigh the coal, etc. The gentlemen interested in building this ship have been (it is understood) well pleased with the mystery that has been hanging around all their movements, and they are certainly entitled to the credit of having supported the enterprise with much cordiality, when even *they* were allowed to know but little of its details. I presume that a portion of this zeal may be attributed to the expectation on their part, of large profits; for the promise of a saving in fuel of 80 per cent. will convince many a man who will hold out against the prospect of fair returns. But to return to the ship. On a visit to Washington recently, I conversed with several engineers who visited her while she was at that port, and saw her engines in motion (the vessel being at anchor). The number of revolutions per minute was from 4 to 4½; the fires were burning bright, and in their opinion, 6 to 8 tons would be the consumption per 24 hours; wheels, 29 feet diameter; paddle, only about 12 inches wide, and dipping under very slightly. Whatever may be the final termination, it is certain that up to the present time the results obtained have not equalled the expectations of the originators of the enterprise. The working pressure is but 8 lbs. instead of 12, and as a consequence, the paddle wheels have been reduced in diameter, and one half the paddles removed. While I really hope that the engine will succeed, and a new power more economical than steam be introduced to the world, I must say that the profound mystery that has been connected with the Ericsson goes far in my mind, to stamp the whole thing as a failure.

H.

For the Journal of the Franklin Institute.

To the Committee of Publications:

GENTLEMEN:—The inclosed diagrams were taken from one of the engines of the steamer *George Collier*, a large first class cotton boat running between New Orleans and Memphis. I could not obtain the dimensions requisite for an analysis of her performance; she carries 850 tons of freight,



INDICATOR DIAGRAMS.	No 1.	No 2.	No 3.	No 4.
Throttle open, ...	·25 inch.	1·25 inch (full).	·75 inch.	·50 inch
Revolutions per minute, .	12½	14		
Difference between boiler pressure and engine pressure, .	26	2 lbs.	8 lbs.	12 lbs.
Mean pres. throughout the stroke,	76	89·9		
Horses power, each engine,	266	353		

250 miles every 24 hours, with 50 cords of the ordinary river wood; her wheels are 34 ft. in diameter, with 11 ft. length of bucket; her valves are of the "balance poppet" kind, and cut off at $\frac{7}{20}$-ths from the commencement of the stroke; the diagrams taken with a "wide throttle" show that the openings are slightly cramped, and that the exhaust valves, or passages, are not large enough; her boilers, furnaces, and heaters are similar to the *Magnolia's*, but not constructed by the same engineer. The "balance poppet" valve was used on the Mississippi fifteen years ago, and found to be so troublesome to keep tight, with the excessive high pressures used, that it was abandoned; within the past four years it has been introduced again, but although with better success than formerly, it is superseded by the "double poppet;" and all the new boats of the larger class are supplied with engines fitted with the latter.

Samuel H. Gilman.

Baton Rouge, La., Feb. 24th, 1853.

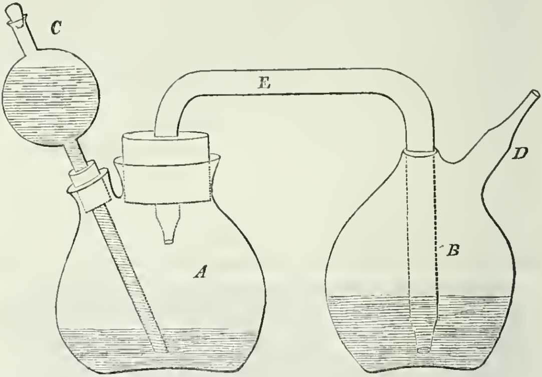
For the Journal of the Franklin Institute.

A New Apparatus for the Determination of Carbonic Acid with Fine Balances. By Charles M. Wetherill, Ph. D., M. D.

The apparatus of Fresenius and Will, for the determination of carbonic acid in certain carbonates, has so generally pleased chemists, that it has been almost universally adopted. As the results have been found by repeated experiment to be very accurate, it has been sought with various success, to modify the form, and to lessen the weight, in order to adapt it to the fine balances in ordinary use. A modification of this kind has been described by Max. Schaffner, in the *Chemical Gazette*, 1853, p. 37, which consists in placing the sulphuric acid in a large test tube, and the carbonate in a smaller one inside the former. In constructing one of these apparatus, I met with certain practical difficulties. The exterior test tube must be taken rather large; if the glass is thin, it risks breaking in fitting the cork; if the glass is thick, the apparatus is heavy. It is rather difficult to obtain a large cork, which will close sufficiently well. The interior test tube is so small, that but a small portion of the carbonate can be accommodated; and, if rich in carbonic acid, it requires a little care in bringing the acid upon it to avoid projecting a portion of the liquid from the tube. The perforation of the corks requires a little care in adjusting, so that the inner tube will readily enter. There are several joints where leakage may ensue, and the corks will have to be frequently removed. The large cork fitting the exterior tube, presents a large surface to hygroscopic action, and the apparatus, as described, will not suit such carbonates the gas of which requires to be set free by hydrochloric or nitric acid. I have no doubt that it would give accurate results in the hands of a skilful manipulator, and it might be improved, either by placing the acid in the small tube, or better by forming it of two separated test tubes smaller than the exterior one, and united as in Fresenius and Will's apparatus.

On the above mentioned grounds, I was led to endeavor to contrive one which would obviate the disadvantages attaching to similar apparatus, and which, with equal accuracy and fewer joints, would be applicable to all purposes to which the Fresenius and Will apparatus is suited.

The apparatus described in this paper, has proved all that is desirable. It is represented in the drawing of the natural size. A, having been washed out and dried, by warming, and drawing air through by means of a tube and cork inserted in the neck, is weighed, after having stood sufficiently long to become cool and to have attained the hygrometric state of its balance case. The carbonate is then added, and the weight a second time determined. After the addition of not too much water to A, the pipette, C, is adjusted, filled with nitric or hydrochloric acid in the case of insoluble sulphates, and empty in the contrary case, where it may be replaced by a simple tube. The pipette is filled by means of a tube and perforated cork, and closed by a wax stopper. After closing, it is warmed by the hand, so that a few drops of acid may escape, and that the acid may not, when cool, reach the extremity of the tube. This tube, if the bore is one millimetre in diameter, does not require to be drawn out at the extremity. B, is now adapted. The addition of water to the carbonate (in the case of dry alkaline carbonates) heats the flask, so that it must become cool before weighing, prior to the evolution of the gas. This is indicated by the rise of the acid in B, which acts as an air thermometer; by which means also the tightness of the joints is ascertained. When acid is used in C, care must be taken that some of it be not expelled by the alteration of temperature of A. When sulphuric acid is used to decompose the carbonate, the air is exhausted by suction at D, by means of a bent tube and perforated cork. The acid may thus be brought into A, and managed with the same control as in the apparatus of Fresenius and Will. The tube, E, is drawn out at both its extremities. It is filled with oil of vitriol by dipping in the acid, and exhausting at D by the bent tube and perforated cork. The last drop adhering to the extremity of E, must be



carefully removed before connecting the apparatus. This acid is saturated with carbonic acid, as will be shown subsequently. During the decomposition of the carbonate, the gas passes through the drop of acid at the end of E, left by forcing the oil of vitriol over, and passing through the tube, the sides of which are also moistened with oil of vitriol, becomes partially dried before reaching the flask B. At the end of the operation, air is drawn through the apparatus. The wax stopper is then fitted to the pipette, and the flask, A, held over a small flame until the contents are in a state of ebullition; the wax stopper is slightly removed, a little more air drawn through, and the apparatus, when perfectly cool, weighed. In analyses where it is necessary to effect the decomposition of the carbonate by acid in the pipette, C, the operation is carried on in an analogous manner.

This apparatus unites lightness with great strength, which is at once *felt* on handling it. This arises from the nature of the joint of E with B, and from the construction of the decomposition flask, which allows E to be made of a piece of stout tube. The one I first constructed and used for the following analyses, weighed when empty 36 grammes; and when charged for analysis, and with much sulphuric acid, together with the hook, between 50 and 60 grammes. It fits the hook which accompanies Oertling's balances for holding the chloride of calcium tube, &c., in organic analysis. An apparatus made of German glass, by Mr. Storm, professional glass blower, weighed when empty, with its corks, 20 grammes.

The Professors Rogers, by violent shaking for 20 minutes, in a peculiar apparatus, having caused sulphuric acid of common density to absorb 94 per cent. its volume of carbonic acid, have, rather hastily I think, rejected the apparatus of Fresenius and Will as liable to error. In one respect every mode of analysis is liable to error; the question should rather be, what accuracy is possible by careful manipulation? The Professors Rogers appear to have rejected this mode of carbonic acid determination, *a priori*, without having given it a fair trial. It has been in almost universal use for some time, and by careful analysts, without objection. Mr. Noad, who also employed it frequently, testifies (*Chemical Gazette*, 1848, p. 176,) to its accuracy, and communicates the results of some of his analyses. Carbonate of Soda yielded, 41·41 and 41·48 per cent. CO_2; theory requiring ($Na = 23{\cdot}178$) 41·37. Carbonate of Potassa 31·81 and 31·84; theory 31·88. Carbonate of Strontia 29·75; theory 29·8.

In answer to Mr. Noad's communication (*Chemical Gazette*, 1848, p. 477,) the Professors Rogers give the results of two experiments, which they say will indicate the amount of error which *may* arise in the process of Fresenius and Will. They have calculated their loss in carbonate of soda equal to a per centage of 0·65 and 1·05. When their experiments are calculated for a loss of *carbonic acid*, 70 grs. gave a per centage loss of 0·27, and 60 grs. a loss of 0·43 carbonic acid, which is not so large that one might despair of lessening it by perhaps more careful manipulation, which the Professors Rogers admit might be done by drawing more air through the apparatus. But these I think are not perfectly fair experiments, since they do not take into consideration small constant errors on the other side, which would tend to more general accurate results; and also they should have been performed on perfectly *pure* and *dry* carbonate of soda, and the results compared with each other and with the theoretical per centage of carbonic acid. Lastly, they did not consider that the sulphuric acid in Fresenius and Will's apparatus is under different circumstances from the acid in their experiments, and also that carbonic acid is readily expelled from liquids in which it is dissolved by a current of air.

Nevertheless, as in a small apparatus like the present, where the small amount of substance taken for analysis renders precautions necessary, which may be neglected in a large one; and also in order to lessen the quantity of air drawn through, I prefer saturating the acid in B with carbonic acid; which is readily effected by adding to dilute sulphuric acid in a test tube (which the cork of the apparatus fits) a couple of crystals of bicarbonate of potassa, and afterward drawing air through.

The following experiments performed with the apparatus, will show its accuracy. The sulphuric acid used was pure and of density 1·76.

About one gramme of perfectly pure carbonate of soda, (which was tested,) yielded in two experiments, a per centage of carbonic acid 41·42 and 41·35, which differ 0·07 per cent. from each other, and of which the mean 41·38 differs 0·01 from the theoretical per centage of carbonic acid 41·37, Na. taken at 23·178, as in Weber's tables.

In order to obviate the use of the tube C, and thereby simplify the apparatus by omitting the tubulus of A, I tried three experiments respectively upon 0·83, 0·859, and 1·0193 grammes of the same salt, which yielded a per centage of carbonic acid 40·93, 40·34, and 40·49. The liquid in the decomposition flask was boiled about as long as in the former series of experiments; but after detaching the apparatus, a more prolonged boiling evolved carbonic acid, which was shown by its precipitating lime water, the precipitate being soluble in hydrochloric acid. The presence of the tube, C, is therefore not to be avoided. The tubulus on A, (though most convenient) may be avoided by passing C through the large cork.

Carbonate of lime, (precipitated, commercial,) which contained sulphate and iron, gave the following results, the carbonic acid being evolved by nitric.

0·63025 and 0·61625 grammes gave a per centage of $CO_2 = 41·65$ and 41·70; difference, 0·05. The theory for *pure* carbonate of lime requires 43·88.

In order to ascertain the amount of error arising from evolving the CO_2 by sulphuric acid, two more experiments were made, which gave for result 38·79, and 39·17 carbonic acid.

Since for a second analysis with this apparatus, it is only necessary to detach the bulb B, (to which a little more oil of vitriol is added if requisite,) and wash and dry A, which is readily effected owing to its size, a series of analyses may be more quickly performed than by Fresenius and Will's larger apparatus, and its accuracy enables it to be employed on small quantities of substance. Its lightness suits it to all balances in general use. The joints are but few and the connexions readily made, while the cork surface is reduced to its lowest possible value. It may be applied to the analysis of manganese, and to all analyses for which Fresenius and Will's apparatus is suitable.

As it is possible that an objection may be raised to the flask B, I would state that it is of quite simple construction. The first one that I attempted, with which the foregoing experiments were performed, succeeded, as did two others made subsequently.

The construction of the apparatus is effected in the following manner: A tube of sufficient size to form the bulb, B, is drawn out, true, and thin at both ends; one end is cut off close to the large part of the tube, which is then slightly flanched. The tube E is then taken of glass of sufficient substance, (of 4 or 5 millimetres exterior diameter and 1 mm. thickness of glass,) and by rotating it in the flame, heating a narrow zone, and pushing together, a thickened ridge, called technically a *marize*, is raised. The extremity which is to dip into the oil of vitriol, is now drawn out and cut off, and the marize is joined to the flanched opening, and well incorporated with it by careful melting. The tube D, the small end of which is closed, is now joined to the large one in the usual manner, inclining it slightly upwards, and the bulb is then blown. If the heating has been properly conducted, the apparatus will result pear-shaped, which is the most suitable form, and D will be inclined at the proper angle. Should D turn out in too horizontal a position, it may be raised by carefully heating its lower junction with the bulb, and bending it upwards, at the same time blowing. The bottom part of the bulb is now cut off, and flattened as in the figure. Lastly, the other extremity of E is drawn out, and E is bent at two right angles. The end of the tube D being cut off, the flask B is complete. It is necessary in drawing out the small end of D, to melt the glass well together, so that the extremity be of the required strength.

A is formed by commencing precisely as with B; but instead of cutting off and flanching one end, the tubulus is at once formed by joining a tube like D, and then blowing the bulb. It will be requisite to incline this tube which forms the tubulus, so that the pipette C will reach the surface of the water in the decomposition flask. The upper extremities of the tubes which form the neck, and the tubulus are now cut off and flanched. When cool, a straight open tube is adapted to the neck by the cork, and the bottom of the bulb cut off and flattened. The joint of the tube E, with the flask B, is very secure, if the glass has been well melted together, owing to the marize. I have heated this flask repeatedly, in drying it after washing it out, without cracking.

I am not aware that a tubulus is ever joined to a bulb *before blowing it*, as here described; and yet such a junction is very readily effected, by one but little skilled in glass blowing, and when well made gives a joint which is absolutely not to be distinguished from the substance of the flask. I have made small retorts with tubulus in this manner; and if it be not already known, I would strongly recommend it to (at least amateur) glass blowers, and especially to those who use lead glass. Messrs. Bullock & Crenshaw, at the corner of Arch and Sixth streets, have procured a supply of this apparatus, made according to my directions.

New Art of Ornamenting Metallic Surfaces.[*]

Numerous as are the inventions or methods which have been applied for the ornamentation of metals within the last few years, we are not aware of any which, for simplicity and beauty, at all equal that recently invented and patented by Mr. R. F. Sturges, of Broad street, Birmingham. It affords the means of decorating plain surfaces of objects formed of metal at a reduction of cost which throws all other processes, devised or invented, into the shade, while at the same time it materially improves their appearance. The invention depends upon the compression of a material between two or more plates of metal in the operation of rolling. It may astonish our readers to learn that the most delicate thread lace, such as is used in ladies' attire, perforated paper, or wire webbing, when passed through a pair of rolls, leaves an impression upon the sheet of metal, corresponding in depth to the compressibility of the material used as the pattern, and the density of the metal upon which the pattern is required to be impressed or indented. Various articles in electro-plate, Britannia metal, &c., such as tea services, salvers, waiters, &c., demonstrate the value of the invention, and show that for all ordinary purposes it is equal to the much more expensive process of decoration by engraving. In the brass foundry trade, the proprietor of the patent, R. W. Winfield, Esq., of the Cambridge street works, intends to introduce the same for the ornamentation of his patent metallic bedstead pillars, curtain bands, &c. Several of the objects we have examined prove satisfactorily the applicability of this class of ornamentation for the purpose. Mr. Winfield, we understand, will supply the metal from his extensive rolling mills in the sheet, which manufacturers and others may convert into such objects as may be required to be made therefrom, and ornamented by the new process. The opportunity now afforded for the production of articles of elegant form and delicately ornamented surface, will no doubt be appreciated.—*Wolverhampton Herald.*

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[*] From the London Mining Journal, No. 906.

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*Notice of the Explosions of Steam Boilers.**

A frightful accident occurred on the premises of the London and North Western Railway Company, at Longsight, near Manchester, on Tuesday morning, March 8th, whereby four men lost their lives, and at least a dozen received serious injuries. It seems that the engine No. 1, an old four-wheeled engine, made by Sharp, Roberts and Co., some fourteen years ago, and one of the first put upon the line, if not the very first, having undergone "a thorough repair," was in the Polygon shed, at Longsight, ready to start to act as pilot engine at the Standedge tunnel, on the Huddersfield and Manchester line. In a few moments more the driver would have taken the engine forward upon the turn-table in the centre of the building, in order that its head might be reversed, when suddenly the men in the Polygon were alarmed by a tremendous report and concussion of air. The place was immediately filled with steam and smoke, and a portion of the building came rattling down, overwhelming a very large number of them. As soon as the smoke and steam had cleared away, the persons uninjured found the tender standing where it had been before the occurrence, with the back wheels of the engine and the plate over them, on which the driver stands, still adhering to the tender; the engine itself was some thirty paces off, beneath the centre of the building, and it was from that the firebox had exploded. On looking for the persons injured, they discovered four men dead in the ash pit next to that upon which the engine had been standing. Seven persons were got from beneath the *débris*, and, having been removed to the Manchester Royal Infirmary, one of them has since died. The cause of the explosion, as far as can at present be ascertained, is clearly over-pressure of steam. The engine, it seems, was worn out; some of the tubes at the side were quite filled up and useless, and some of the long stays were corroded very much; facts which seem to prove a want of supervision. The force of the concussion was so great, that it blew away every window in the shed, although the frames were cast iron; and it lifted up the floor of the reading room, and threw the men from their seats. Three cast-iron pillars, 27 feet long, and about 12½ inches in diameter, were thrown down with the roof. We have collected all the evidence upon the inquests that have been held; but, as other and more stringent investigations are in hand, we defer our remarks until their completion.

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* From the London Artizan, April, 1853.

A locomotive boiler has exploded at the Brighton station. At about ten minutes to seven, the engine of the short train which leaves Brighton for Littlehampton daily at 7·15 was standing attached to its train, and ready for departure, when it exploded suddenly, and the various parts of the machinery were driven through the roof of the shed under which it was standing. The driver, the fireman, and a fitter, who were upon the engine at the time, were killed, and their bodies were found at some distance from the engine. Although some of the passengers were seated in the train, they all escaped without the slightest injury. From evidence already obtained, the directors have too much cause to believe that the accident arose from the driver having screwed down the safety valve shortly before the explosion took place. On the inquest, Mr. Chester Craven, locomotive superintendent, said, in answer to the coroner, that he had foremen in different departments to inspect everything; he himself interfered only when his attention was called to serious defects. The exploded engine was built by Messrs. Rennie in 1840, but had been patched and patched, till it had been nearly rebuilt. On the 4th of March, it was inspected by Ardron, inspector of working engines, and pronounced perfect. It had run 95,000 miles; but they expected 300,000 miles from an engine before parting with it. In 1840 boilers were made with 5-16ths plates, but now with 7-16ths. They did not put new boilers into engines. When a boiler had worn out two new boxes and two new sets of tubes, the engine was given up. He believed that this accident arose from over-pressure, arising from the safety valve being unduly pressed down.

A fatal steamboat explosion occurred on board the *Engineer* steamboat, off Tyne bar, on Thursday, the 10th March. One of the joiners, who was scalded, is dead, and a baker, of the name of Elliott, is in a very dangerous condition. The other seven persons scalded, though suffering much from the wounds they sustained, are recovering. It seems the *Engineer* was a new vessel, and was making her trial trip. She left Mr. Almond's works about five o'clock in the afternoon, with about twenty persons aboard, and had crossed the bar, and got about a mile and a half to sea, when the explosion took place. In a moment, and without any previous warning, what is called the "tubing" of the starboard boiler gave way with a terrible noise, the steam and water washing the coals from the coal-hole into the fore cabin, and bursting open a portion of the deck, some of the planks of which were blown into the sea. The boiler has since been carefully examined, to ascertain the cause of the explosion, and a wooden plug has been found in the boiler that exploded. The presence of the plug, and the origin of the explosion, are accounted for in this way:—The boat has two boilers, one on the starboard, and one on the larboard side. They are connected together by a pipe which feeds the engine and communicates with the safety-valve. The pipe is screwed on to the boilers at each end, and, to prevent the escape of steam, is also cemented at the ends. Before screwing the pipe to the boiler, a wooden plug is driven in, to keep it steady, but which is taken out after the screws are fastened. The plug fastening the piping to the starboard boiler, there is every reason to believe, had been forgotten by the workmen, and left in, and, effectually preventing the steam from escaping, had occasioned the explosion.

AMERICAN PATENTS.

List of American Patents which issued from March 8th to April 5th, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

MARCH 8.

9. For an *Improvement in Printing Presses;* Seth Adams, Boston, Massachusetts.

Claim.—"Having described my improvements in printing presses, what I claim as my invention is, 1st, The combination of said vibrating platen with the sheet holders, arranged as herein above specified, so as to be kept up a little distance from the platen, when in position to receive the sheet, and moving with said platen to the form, in order to hold the sheets thereon, and draw them from the type, also with the gauges for separating the sheets. 2d, I also claim the mode or means herein above described, for keeping the sheet holders up from the platen, when the sheet is to be placed; said means consisting of an arm on each end of the rod, (on which said holders are fixed, and with which they turn,) and stops, against which said arms strike; the arrangement and operation being substantially as herein above set forth. 3d, I also claim the apparatus for delivering or taking off the sheets from the platen, after it is printed, consisting of the moving or sliding tympan cloth, in combination with the turning segment, to which an intermittent and reciprocating rotary motion is imparted by the catch, ratchet, and spiral spring, operating as above specified."

10. For an *Improvement in Cane Juice Evaporators;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1852.

Claim.—"Having described the nature of my invention, and the manner of constructing the same, what I claim is, the combination of a hollow and perforated shaft, connected with an air blast apparatus, a series of plates, or a screw plate, placed around and on the shaft, and a reservoir trough or basin, for holding the liquor to be evaporated, all substantially as above specified. 2d, And I also claim the combination of a hot water vessel and its heating apparatus, the cistern for holding the saccharine liquor, and the apparatus for effecting its evaporation, by means of hot air blown on thin or extended surfaces, a screw or plates, as specified."

11. For an *Improvement in Filters for Cane Juice;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1852.

Claim.—"Having described my invention, what I claim is, the combination of the receiving vessel, the rotating filtering drum placed within the said vessel, the gutters within the drum, the hollow axle or shaft connected with said gutters, and the scraper applied to the outer surface of the revolving drum; the whole being arranged and made to operate together, substantially in manner and for the purpose as herein before specified."

12. For an *Improvement in Machines for Breaking and Dressing Flax;* Stillman A. Clemens, Springfield, Massachusetts.

Claim.—"What I claim as my invention is, the method of breaking and dressing flax or other fibrous substances, by a beater constructed in the manner described, (vibrating on a central axis,) between the faces of which the flax, &c., passes as described, when this is combined with one or two pairs of rests placed in close proximity to the edges of the beaters, between which the flax passes, substantially as described. And I also claim, in combination with the beater and rest for breaking and dressing as described, the employment of a pair of rollers, each of which is grooved in the direction of its periphery, and one of which is made to vibrate in the direction of its axis, for the purpose of opening and softening the fibres, substantially as herein described."

13. For an *Improved Magnetic Machine for Washing and Separating Gold;* Samuel Gardiner, Jr., City of New York.

Claim.—"I do not claim to have invented a rotary cylinder of magnets, for the purpose of separating magnetic particles from ores or metals; but what I claim as my invention is, separating gold or other metals from earthy or other magnetic particles, by means of a rotary cylinder of magnets, which magnets, at the same time that they collect the magnetic particles, serve as agitators for agitating the water and the metal, and earthy and other foreign matter with which it is mixed, for the purpose of washing away the said earthy and other foreign matter; the said cylinder of magnets being constructed and arranged, in relation to the trough containing the aforesaid mixture, in any way substantially as herein set forth."

14. For an *Improvement in Daguerreotype Plates;* J. F. Mascher, Philadelphia, Pa.

Claim.—"I do not claim the invention of the stereoscope, for that has been previously discovered; but what I claim as new is, constructing a daguerreotype case with an adjustable flap or supplementary lid, said flap or lid being within the case, and having two ordinary lenses placed in it, by which, by adjusting the flap or lid as shown, a stereoscope is formed of the case, and the two daguerreotypes, by binocular vision, are apparently formed into a life-like figure."

15. For an *Improvement in Machines for Moulding in Flasks;* Lysander A. Orcutt, Albany, New York.

Claim.—"Having fully described the nature of my invention, what I claim therein as new is, in combination with a flask having a continuous or reciprocating rotary motion, the rammer or rammers, so arranged as to be made at any time during their operation to work in any portion of the flask, whilst at the same time they have an automically adjustment, so as to rise as the flask is filled and rammed, and adjust themselves vertically in regard to the flask; the whole being accomplished substantially in the manner described."

16. For *Improvements in Moulding for Cast Iron Plates with Dovetailed Recesses;* Thaddeus A. Smith, Albany, New York.

Claim.—"I claim the process of moulding the recesses in the tops of stove plates, intended for the reception of the lifters by which such plates are handled, (which recesses are required to be dovetailed,) by employing pattern cups shaped to form such recesses, divided by a vertical cut into two parts, so that the said cups can be removed from the core formed by them, by moving each division of it horizontally from the core before raising it off the sand, and by fitting the cup pattern into the pattern of the stove plate, so that the plate pattern can be lifted from the sand, leaving the cup behind it, substantially as the same is set forth in the above specification."

17. For an *Improvement in Machines for Dressing Shingles;* Joel Tiffany, Cleveland, O.

Claim.—"What I claim as my improvement is, the combination of parts consisting of the pinions, with the intermediate gears, the levers, and joint levers, and sections, with the connecting rods and cam, for the purpose of operating the arms, as described, viz: turning and removing shingles at the same time, from one side of a reciprocating bed to the other, and then when its second face is dressed, throwing it from the machine in a finished state."

18. For an *Improved Cannon Sight;* John J. Wagener, Charleston, South Carolina.

"The nature of my invention consists of an easy and correct mode of determining the highest point of the surface of a cannon, regardless of any position which the wheels on account of any uneven surface may occupy, and of affording the gunner at the same time, a perfect sight to direct and elevate the piece by, capable of regulation for any distance less than point blank, as well as to extreme range, according to degrees."

Claim.—"What I claim as my invention is, the sighting apparatus, consisting of the corresponding pendulum, as described, hung between the graduated side pieces, or uprights, in connexion with the protecting and regulating slide, with its rifle sights; said pendula having free sway, by means of the rotary mounting of the uprights and upper part of the apparatus on the screws and pivots, and the whole being attached and shifted into horizontal position on the cannon, by means of the movable spring clasps, all constructed and combined substantially as set forth."

MARCH 15.

19. For an *Improvement in Turning Lathes;* Warren Aldrich, Lowell, Massachusetts.

Claim.—"Having described my improvements in turning lathes, what I claim as my invention is, 1st, the improvement herein above described, which consists in giving an automatic motion to the upper slide or tool rest. when set at any angle to the bed piece of the lathe, instead of moving it by hand, so as to turn with ease and accuracy, solid or hollow cones, as above set forth, by means substantially of the screw, revolving worm shaft, and revolving plate, as above set forth."

20. For an *Improvement in Machines for Expressing Sugar Cane Juice;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1853.

Claim.—"Having described my invention, what I claim is, the improvement of constructing each of the cane pressing tubes, substantially as specified, viz: with sides made parallel some distance, (for the working of the piston against,) and to approach one another towards the mouth of discharge of the pressed cane, whereby advantages as above mentioned are obtained. I also claim the combination and arrangement of two compresses, or pressing tubes, and two conjoined pistons, with one revolving actuating shaft, and its mechanism, to give to their plungers or pistons a simultaneous reciprocating rectilinear motion, all as represented."

21. For an *Improvement in Heaters for Sugar Syrup;* Henry Bessemer, Baxter House, England; patented in England, February 24, 1852.

"I am aware that in locomotive engines, water has been heated by standing in tubes exposed to the flame or direct heat of a furnace; now such a mode of heating will not answer for the treatment of the saccharine syrup, as the heat of a furnace is not susceptible of regulation as is that from steam, the latter not burning the syrup or injuriously heating it, as would the former. I have discovered that the heat of steam applied to syrups in manner described, in connexion with the action of gravity, produces advantages in rapidly heating the syrup, unattainable by any process where the syrup is passed through pipes, heated by direct heat or the flame of a furnace. It is, therefore, that I expressly disclaim the mode of heating water by allowing it to flow through, or stand in tubes heated by the direct heat of a furnace, but base my invention on the above described method of treating saccharine syrup by means of the apparatus represented, as there arranged and constructed, to operate for the purpose set forth, by the power of gravity and steam; the same consisting of a combination of the receiving vessel, the series of tubes, the chamber and its pipe, and the steam chamber, having induction and eduction pipes, as specified."

22. For *Improvements in Supporting the Topping Lift and Peak Halyard Block of Sail Vessels;* William and S. G. Coleman, Providence, Rhode Island.

Claim.—"What we claim as our invention is, the supporting the topping lift by means of a crane of such form and construction, that when the topping lift sags when the sail is hoisted, it shall not foul or chafe against the peak halyard block. We also claim the so arranging and constructing such crane that it may also support the peak halyard block, substantially as specified."

23. For an *Improvement in Rocking Chairs;* Peter Ten Eyck, City of New York.

"The nature of my invention consists in combining with a chair, so arranged as that the top of the seat shall rock upon the bottom part, whilst the legs remain stationary, a safety guard, to prevent the chair from going back too far, and also to prevent it from going suddenly backward, when the person seats himself in it."

Claim.—"Having fully described the nature of my invention, what I claim therein as new is, in combination with a sitting chair, so arranged as that the seat may rock upon the legs or support, the safety piece or guard, hung eccentrically to the pivot of the bar on which it rests, and the spring for preventing the top part of the chair from rocking too far or too suddenly, substantially as herein described."

24. For an *Improvement in Knitting Machines;* Moses Marshall, Assignor to M. Marshall, W. Aldrich, and L. B. Tyng, Lowell, Massachusetts.

Claim.—"Having described my improvements in knitting looms, what I claim as my invention is, 1st, Constructing the rotary depresser and the feeder which carries the thread, with the arm which connects the reciprocating cam bores, substantially as above described. 2d, Dividing the plates which support the needles and cast the stitches at the angle of intersection of the two sets of needles, so that the fabric knit will or may pass between them. 3d, I claim forming the stitches alternately on each side of the needle rests, by two sets of needles placed at an angle to each other, and operating one needle at a time, substantially as above set forth."

MARCH 22.

25. For an *Improvement in Hydraulic Steam Pumps;* Horatio N. Black, Philadelphia, Pennsylvania.

Claim.—"I do not claim a double cylinder pump or water engine; nor do I claim opening a valve at the end of the stroke of a steam piston, and injecting water into a steam cylinder, for producing a partial vacuum; but what I claim as my invention is, the combination of the double slotted water and steam cylinder, double pistons, and slotted piston rod, arranged and operating in the manner and for the purpose set forth in the foregoing specification."

26. For an *Improvement in Separating Paper by Single Sheets;* John P. Comly, Dayton, Ohio.

"My invention consists in a method of feeding or supplying paper, sheet by sheet, from a heap, through the agency of atmospheric pressure, and having reference especially to the instances in which the sheet has to be raised and drawn forward by one edge, as in the case of printing, and is intended to supersede the services of the attendant now found necessary to feed the machine."

Claim.—"What I claim herein as new is, 1st, A table or range of tubes, connecting with an exhaust pump or vacuum, for separating the edge of a sheet from a heap of paper by atmospheric pressure, in combination with a roller or its equivalent, traversing to and fro on the upper sheet, for the several purposes of lowering and admitting air between the leaves, presenting the edge of the top sheet to the tubes, and (on its backward stroke) serving to straighten the pile. 2d, The tube or tubes aforesaid, in combination with the vibrating supporting bar, for upholding the forward edge of the sheet, when dropped by the tubes, presenting it properly to the fingers, and supporting it from the heap, while being drawn away."

27. For an *Improvement in Tanning;* Roswell Enos and Bela T. Hunt, St. Charles, Illinois.

Claim.—"What we claim is, the process of tanning, with the use of lime, salt, bran, sumac, and cutch, or any other tanning in room of cutch, substantially in the manner above described, whereby we commence tanning at the same time that we commence reducing; as the salt and bran overpowers the lime, the tan takes the place of the lime and converts the hide into more perfect leather, and in less time than can be made in any other way. Hides are not liable to get damaged by our process, as we do not use an article that is injurious to leather. It is not on the materials used that we claim letters patent, but on the manner of applying them to the hide, as set forth in the schedule."

28. For an *Improvement in Cheese Presses;* Mills A. Hackley, Belleville, New York.

Claim.—"What I claim as my invention is, the turning table, or its equivalent, in combination with the roller, in such manner that whenever the table is adjusted for turning the cheese, there will be a corresponding adjustment of the roller, for facilitating the process of turning the same."

29. For an *Improvement in Knitting Machines;* Wm. Mansfield, Dracut, Mass.

Claim.—"What therefore I claim as my invention is, the above described improvement in forming the loops in knitting ribbed fabrics, viz: by the combination of two sets of needles made to operate together, substantially as herein before set forth; the same enabling me to gain important advantages in the construction and operation of the loom."

30. For an *Improvement in Processes for Distilling Rosin Oil;* James Riley and Wm. Allen, Southfield, New York.

Claim.—"Having fully described the nature of our invention or discovery, and shown one of the methods of reducing it to practice, what we claim therein as new is, the process by which we manufacture oil from rosin, by passing it from an alembick through expanding worms, or their equivalents, surrounded by a jacket of fire-brick or clay, whereby we prevent destruction, distillation, carbonization, and greatly economize time, substantially as set forth."

31. For an *Improvement in Harness:* James Stanbrough, Newark, New York.

Claim.—"What I claim is, the forming of rounds, raises, or rolls, on the different parts of a harness or other leather work, by doubling and stitching together a strap of leather at its edges, and then binding these edges by a separate piece, and connecting the stitching of such binding, by drawing up and fastening by the side thereof, folds of the strap; and this I claim, whether the single strap only be used for forming a single roll, or a secondary strap be used for forming two or more rolls, substantially as described."

32. For an *Improvement in Machines for Pegging Boots and Shoes;* Seth D. Tripp, Rochester, Assignor to Edward L. Norfolk, Salem, Massachusetts.

Claim.—"What I claim as my invention is, the combination of each frame with its supporting shaft by means of a rocker frame; the same being for the purpose of allowing a free vertical as well as other movements, as above described, of either of the frames, so that it may be guided in its vertical movement by the curvature of the upper surface of the sole of the boot or shoe, and horizontally by the cam wheel, substantially as above specified. I also claim the manner of combining the awl and driver with one carrier, made to operate substantially as above described, whereby they are alternately presented or brought down against or towards the sole by the revolution of the carrier, substantially in the manner as above specified. And I also claim the combination of the guide with the knife or chisel, and so as to operate therewith substantially as specified, in the manner and for the purpose of guiding said chisel properly against the peg wood, as described. I also claim the improvement in the construction of the charger, viz; the making of the same with two or more separate compartments, for holding the strips of peg wood, which compartments are to be successively brought forward, under the operation of the piston slide, as the several pieces or slips of peg wood are successively cut up into pegs, meaning to claim a combination of a series of compartments, with one single piston slide, made to operate substantially as above set forth. I also claim the combination of mechanism by which the charger is moved; the same consisting in the operating spring, the rack, the click or pawl, and the spring, applied to the upright part of the pawl, the whole to act in conjunction with the piston slide as above described. I also claim the combination of mechanism for operating the slide, the same consisting of the rack or ratchet thereof, the impelling pawl, the spring lever, the cam, the ratchet wheel, and the spring hook pawl, as applied to the frame and the bar and made to operate, substantially as above set forth; the same causing peg wood to be shoved through the charger, and keeping the pegs in advance of the peg wood, and successively forcing them into the correct position, over the hole made in the sole by the awl. And, in combination with the pressure spring, I claim the lever with its bent projection, spring, bent lever, and cam; the same being for the purpose as above set forth."

MARCH 29.

33. For an *Improvement in Preparing Lubricating Oils;* Luther Atwood, Boston, Massachusetts.

Claim.—"What I claim as my invention is, the coup oil, or new manufacture, (or combination of paranapthaline and fixed oils derived from coal tar, and boiling from four hundred and fifty degrees to six hundred and seventy-five degrees Fahrenheit,) as produced by the process substantially as herein before described; the said new manufacture being highly useful as a lubricating composition, either alone or combined with oils or fatty matters, as above set forth. I also claim the combination of this product, so made with concrete or thick fatty matters, or oils, for the purpose of liquifying them or rendering them more mobile, or imparting to them lubricating qualities, as herein before specified."

34. For an *Improvement in Winnowers of Grain;* Schuyler Briggs and John G. Talbot, Sloansville, New York.

Claim.—"What we claim as new is, causing the upper sieve or riddle to vibrate at a greater speed than the screws, in the manner and for the purpose herein set forth."

35. For an *Improvement in Machines for Breaking Hemp;* Lewis W. Colver, Louisville, Kentucky.

Claim.—"Having fully described my invention, what I claim therein as new is, the combination of the oscillating beaters and the spring bars, placed above and below said beaters, so that the recoil of the springs, after the beater leaves the bars, shall shake out the hemp and clear it of its woody portions, substantially as described."

36. For an *Improvement in Hot Air Furnaces;* Wm. Ennis, City of New York.

Claim.—"What I claim as my invention is, 1st, the employment of an inverted cone within a drum or cylinder, in whose side the taper end of said cone is inserted, and allowed to communicate with the "atmospheric reversing draft," to cool the direct heated current from the fire; the said cylinder communicating with the fire chamber and ash pit, in the manner and for the purpose substantially as herein described."

37. For an *Improvement in Electric Telegraphs;* Moses G. Farmer, Salem, Mass.

"The object of my invention is, to enable a common telegraphic circuit, extending between any two places, to be used by two or more operators at the same time, instead of but one operator, as it is at present; or in other words, suppose that we are to have four operators stationed at one end of the line, and each conducting or operating a single key or instrument for breaking and closing the circuit; also, that we wish to communicate with four persons at the other end of the line, by means of four signal instruments there placed."

Claim.—"What I claim as my invention is, the method herein above described, of bringing any number of telegraphic signalizing and recording instruments into successive electric connexion with the common communicating wire; meaning, more particularly, to claim the combination of the writing and working, or primary and secondary circuits, the electro-magnets and movable armatures of the primary circuit, the local magnets and their movable armature and pallets, or equivalents therefor, and local battery and battery connexions of each terminus, and connexions leading to the armatures of the local magnet, the escapement wheels, and wheels on the arbor of each, the two series of springs of said wheels and branch connexions, and the branch connexions of the main writing circuit at its two termini; the whole being connected and made to operate together substantially as described."

38. For an *Improved Pendulum Balance for Quick Weighing;* Benjamin Fenn, Hartford, Ohio.

Claim.—"What I claim as my invention is, a machine for ascertaining, instantly, the weight of bodies, by means of a scale, dish, or plate, supported by pivots upon a heavy or weighted semi-circular frame, or its equivalent, in the manner of a pendulum, and operated upon by catches, substantially as herein described."

39. For an *Improvement in Seed Planters;* Isaac H. Garretson, Clay, Iowa.

Claim.—"What I claim is, planting corn in check rows, by the planting sides worked on the cross bar by hand, in the manner set forth."

40. For an *Improvement in Knitting Machines;* John Maxwell, Galesville, New York.

Claim.—"I claim the construction of the locking apparatus, by placing standards upon the back ends of the half-jacks to carry springs, which regulate the pressure of the bar upon the jacks, in combination with an apparatus for raising said locking bar; the whole constructed in the manner substantially as set forth in the within specification."

41. For an *Improvement in Paging Bound Books;* John McAdams, Boston, Massachusetts; ante-dated September 29, 1852.

Claim.—"Now, I do not claim the use of type chains for paging books, as they have already been secured to me by letters patent granted August 12th, 1852; but what I do claim as new is, the employment of the square rotating shaft, d, as a bed for the odd numbers, and the shaft, d^1, as a bed for the even numbers of the types, in combination with the tongue, as a platen to both sets of types, the same being operated by the treadle, ratchets, and pawls, so as to enable the operator to print the odd and even numbers of the alternate pages of a bound book, by the single movement of the treadle as above described."

42. For an *Improved Arrangement of Die Rollers in Spike Machines;* James H. Swett, Boston, Massachusetts.

Claim.—"Having fully described the nature of my invention, what I claim therein as new is, skewing the shafts or axes of rotary printing dies, so that they shall stand oblique to each other, and beveling off the faces of the dies to the same, or about the same angle at which the shafts stand to or cross each other, for the purpose of forming a close fitting space in front of the dies, or where the blank is fed in, and spreading the dies in rear, or behind, where the spike is pointy, so as to release it and allow the nippers to take the spike from the pointing dies without injury to the spike, substantially as described."

43. For an *Improvement in Vertical Pianos;* George Traeyser, Cincinnati, Ohio.

Claim.—"I claim as new, the construction as described, of a vertical piano, having the tuning pins placed below the lower edge of the sounding board, for the objects herein explained."

44. For an *Improvement in Sewing Machines;* Thomas C. Thompson, Ithaca, N. York.

"The nature of my invention consists, first, in charging the race or shuttle with magnetism, for the purpose of keeping the shuttle in perfect contact with the face of the race, without the use of springs or holders of any kind, whilst, at the same time, I insure the taking up of every stitch; also, in making the shuttle with a hinged cap, for the more readily placing therein and retaining of the bobbin or cop, which is used without a spindle or spooler; the thread being drawn from the inside of the cop or bobbin, by which means an uniform strain or tension is preserved on the bobbin or cop thread."

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, 1st, the magnetic shuttle and race, one or both, for the purpose of keeping the shuttle in perfect contact with the face of the shuttle race, without the use of springs or any other device, and thereby insuring the securing of every stitch, substantially as described. I also claim the curved and hinged cap, in combination with the shuttle, to confine the cop in the shuttle, substantially and for the purpose set forth. I also claim the use of a cop without a spindle or spooler, in combination with a shuttle, or its equivalent, when the thread is drawn from the inside of the cop, by which means I retain an uniform draft on the cop thread as it is drawn or paid out from the shuttle, substantially as described."

45. For an *Improvement in Wire Fences;* Matthew Walker, Matthew Walker, Jr., and Daniel S. Walker, Philadelphia, Pennsylvania.

Claim.—"What we claim as our invention is, first, the arrangement of the hooks within the mortises, so that the parts of the hook shall be sustained and kept from spreading by the mortises, and a strain upon the wires tend to steady the posts, as described."

RE-ISSUES FOR MARCH, 1853.

1. For an *Improvement in the Mode of Operating Brakes for Cars;* Nehemiah Hodge, North Adams, Massachusetts; patented October 2, 1849; re-issued March 1, 1853.

"My invention consists in a combination of mechanism, which, when applied to or connected with the brakes of two trucks or truck frames of a railway car, and two windlasses, respectively situated at the two ends of the floor frame of a car, shall, when either windlass is put in rotation so as to wind up its chain, bring down at the same time, the brakes of both truck frames upon the wheels thereof with the same degree of force, and whether when the car is running on the railway, the axles of the wheels of one truck are thrown or moved out of parallelism with those of the other truck, or the rubbers or brakes become unequally worn, or are of an unequal thickness."

Claim.—"I am aware that the brakes of a car made with trucks or truck frames have, before the date of my invention, been connected in different ways, so that the brakes of both trucks could be brought down simultaneously upon the wheels, by the action of either windlass. I therefore do not claim any machinery for doing merely this, but when this has been done, the machinery applied to the windlasses and brakes of the trucks has not been such as to cause, under all, or nearly all circumstances, while the car is in operation, or running on a railway track in which there may be curves or deflexions from straight lines in the laying of its rails, and when either windlass is put in operation, the like amount of force which may be brought to act upon the brake lever of one truck, to act through the movable rod or connecting mechanism upon the brakes of the opposite truck. I therefore claim my improvement in actuating the brakes of a car having two trucks; that is to say, I claim a combination of two levers, f, f^1, a rod, h, two levers, c, c^1, and rods, d, d^1, as applied to the brakes and two windlasses of the car, and operated by either of the windlasses, so as to bring down at the same time, the brakes of both trucks upon the wheels thereof, with the same, or practically the same degree of force, and whether when the car is running on the railway, the axles of one truck, or of the wheels of one truck, are thrown or moved out of parallelism with those of the other truck, or rubbers, or brakes, become unequally worn, or of an unequal thickness, as above stated."

2. For an *Improvement in Splints for Fractures;* Adam Hays, Pittsburg, Pennsylvania; patented August 13, 1850; re-issued March 8, 1853.

Claim.—"What I claim as my invention is, the cutting out a portion of the splint, to afford an opportunity for dressing as often as may be necessary, the upper and lower portions of the splint being kept firmly united by means of the brace, so as by extension of the parts concerned; the slide being replaced after each dressing, or any other device substantially the same."

3. For an *Improvement in Self-Acting Mules for Spinning;* Wanton Rouse, Taunton, Massachusetts; patented November 2, 1852; re-issued March 15, 1853.

Claim.—"What I claim as my invention is, 1st, Governing the revolution of the spindles in winding the yarn on the cop, and also in backing off during the progressive stages of the building, by means of a cam, or any equivalent device of irregular form, circumferentially, with the said irregularity, varying from end to end; the said cam or equivalent being caused to operate upon the mechanism which drives the spindles, in any way that will produce the results herein set forth. 2d, The mechanism for causing the finger through which the irregular surface of the cam, or its equivalent, acts upon the mechanism which drives the spindles in backing off and building on, to traverse the said cam, and to be kept close to its surface, consisting of the screws, *e* and *k*, the nut, *j*, cord or chain, *f*, lever, G, and stud, *h*, operating in combination, in the manner substantially as set forth."

4. For a *Machine for Arranging and Feeding Screw Blanks;* Thomas J. Sloan, City of New York; patented February 25, 1851; re-issued March 29, 1853.

Claim.—"What I claim as my invention are, the lifters, which select and lift the blanks, etc., from the hopper, substantially as specified, in combination with ways or conductors, or the equivalents thereof, substantially as specified, into, or on to which the blanks, etc., are transferred as specified. And I also claim giving to the lifters, or to the inclined ways or their equivalents, a lateral motion, in combination with a stop or detector, substantially as specified, for the purpose of arresting the operation of the lifters, until a farther supply is required, as specified. And finally, I claim the sliding carrier with its recess for receiving and holding the screw blanks, substantially as specified, in combination with the spring fingers, substantially as specified, for taking the screw blanks from the carrier, and presenting them to the jaws, as specified."

APRIL 5.

1. For *Improvements in Process for Forming Yarn by Felting;* John H. Bloodgood, New Jersey.

"The nature of my invention consists in the production of a strong felted roving or untwisted thread of wool, capable of being employed for warp or weft, in making woven cloth, or for knitting, sewing, and other purposes."

Claim.—"What I claim as my invention is, the formation of thread or yarn from woolen rovings, by the process of felting instead of twisting or spinning, substantially as herein set forth."

2. For an *Improvement in Grain Harvesters;* Thomas D. Burrall, Geneva, New York.

Claim.—"In the machine above described I claim, 1st, the additional apron to convert the usual rear discharge into a side discharge of the cut grain, constructed and arranged substantially in the manner set forth. 2d, I claim the combination of the curved supports and the adjustable journal box piece, to preserve the relative positions of the cogs in the mitre gearing, and at the same time allow of raising and depressing the driving wheel; the gearing, &c., being constructed and arranged as described and represented."

3. For an *Improvement in Ploughs;* Solomon Horney, Jr., Richmond, Indiana.

Claim.—"Having thus fully described my invention, what I claim as new is, constructing the shank hollow, in a single piece with two closed ends, substantially as described, and securing the same to and with the share and beam, by means of master bolts and the short bolt, for passing through the slot in the top end of the hollow shank, for varying the position of the shank with the beam, and for giving additional security to the fastening of the same, substantially as herein set forth."

4. For an *Improvement in Water Metres;* Wm. H. Lindsay, City of New York.

Claim.—"I do not claim operating the valves of the main engine or cylinders by means of a secondary or independent engine, the valves of which are actuated through the medium of the primary engine, the same being well known in the construction and operation of hydraulic engines, &c.; but what I do claim as my invention is, 1st, operating in the manner and for the purpose herein described, the valves of a secondary engine, by the main engine, through a portion of their movement, and completing the same through the medium of the secondary engine. 2d, Connecting the cross head of the main cylinder, in case the working parts of the secondary engine should fail to do their duty. 3d, I do not claim the balancing of slide valves, as such has heretofore been done in various ways; but what I do claim is, forming a recess or recesses, in the under or working side of the slide valve, in combination with the secondary opening or openings through the seat, or in the side of the port or ports, for the purpose and in the manner substantially as herein described. 4th, I do not claim making a connexion between opposite sides of the plunger piston, at a certain portion of its travel, as that has heretofore been done; but what I do claim is, the combination of the bridge in the cylinder, in combination with the openings in the plunger, for the purpose and in the manner substantially as herein described."

5. For an *Improved Apparatus for Feeding Blanks to Screw Machines;* Thompson Newbury, Taunton, Massachusetts.

Claim.—"What I claim therein as new is, the slide, substantially as herein described, passing up through the bottom of the hopper in the manner set forth."

6. For an *Improved Arrangement of Sash Fasteners;* Henry R. Noll, Lewisburgh, Pa.

"My invention and improvements consist in so arranging the spring catch fastenings for window sashes, that the spring for the upper sash may be commanded without interference with the lower sash; that is to say, if the lower sash is raised, the spring of the upper sash can be managed without dropping the lower sash."

Claim.—"What I claim as my invention is, 1st, Arranging the spring catch fastenings for the upper and lower sash, about the middle of the frame, in such a manner that the upper sash can be managed, or fastened and unfastened, without interference from the lower sash, substantially in the manner herein set forth. 2d, I claim the particular arrangement of the attachments on the one plate of the two spring fastenings; said arrangement consisting of the swing bar, (through which the spring bolt of the upper sash is operated,) with its hinge joint in the rear of the spring bolt, and the bar and bolt of the lower sash, by which I gain economy of room, and a cheap and efficient action upon the two sashes, in the manner set forth."

7. For an *Improvement in Processes for Preparing Vegetable Fibre;* Chas. J. Pownall, Addison Road, England; patented in England for Ireland, August 11, 1852.

Claim.—"I claim as of my invention the mode of subjecting fibrous vegetable substances to repeated mechanical pressure and the action of a stream of water, for the purpose of depriving them of resinous or gummy matters, and also resolving them into their ultimate or finer fibre, in manner herein before described."

8. For an *Improvement in Sector Presses;* Samuel Rust, City of New York.

Claim.—"What I claim as my invention is, 1st, one or more bearing pieces at the sides or in front of the eccentric sector, acting upon any fixed point or rest on the press frame, for the purpose of raising or withdrawing the punch or pressing appendage, by power applied to the sector, in the reverse direction to that by which the pressure is given, substantially in the manner specified. 2d, I claim allowing to the eccentric sector a sufficient amount of motion directly in the line of the pressure, to enable it to follow, and always keep in contact, and in proper relation to the eccentric sector, substantially as herein set forth."

9. For an *Improved Machine for Cutting the Threads of Wood Screws;* Elliot Sawyer, Berlin, Connecticut.

Claim.—"I do not claim the invention of the combination of mechanism for holding and rotating a screw blank, and mechanism for carrying a cutter or chisel against the blank, and regulating the movements of that cutter by a screw; but what I do claim as my invention or improvement is, the endless elongated chaser, as constructed and made to turn and move on a pin, or its equivalent, and to act against a screw blank while in rotation and movement, as specified. And in combination with the elongated endless chaser and the screw blank holder, I claim the feeding cam or apparatus, so applied as to be operated by the chaser, and feed it forwards against the screw blank, substantially as specified. And in combination with the elongated endless chaser and its sustaining carriage, I claim the movable rail and groove, together with mechanism for elevating and depressing the rail, in manner and for the purpose as stated; the mechanism as above described for such purpose being the two grooves and their inclined planes, and the studs and the springs of the rails. And in combination with the elongated endless chaser and its operative screw, and elongated endless worm gear, and the feeding apparatus of the chaser, I claim mechanism for withdrawing the driverfrom the head of the screw, or releasing the screw from the machinery by which it is put in rotation; mechanism for removing the cut screw from the endless chaser, and presenting another screw blank to the operation of it, as described; and mechanism for restoring the driver and other parts to their correct positions, to again set in motion the screw cutting machinery; the machinery, as described for actuating the driver, being the cam, the pitman, the rocker shaft, the bent arm, and the forked lever; that for removing the cut screw from the chaser, and presenting to it a fresh screw blank, being the rotary blank holder, the gear wheel, and the arms; that for restoring the driver and other parts to their correct positions, to again set in motion the screw cutting machinery, being the pitman and the spring; the whole being applied and made to operate together, substantially as specified."

10. For an *Improvement in Weaving Corded Fabrics;* Wm. Smith, City of New York.

"The object of my invention is to furnish means for weaving fabrics formed by a centre warp of india rubber, for corrugated elastic goods, or any similar warp which is enclosed by a fabric formed on each side of it, by filling from two shuttles, one passing above and the other below the centre warp, which is stationary, the sheds being formed by upper and lower warps, worked in any usual manner."

Claim.—"I do not claim two shuttles, as two or more have been used in various kinds of weaving; but what I claim is, the process of forming a fabric by the combination of stationary movable warps, with two weft threads passed simultaneously through the two sheds formed above and below said stationary warps by the movable warps."

11. For an *Improved Process for Mixing Air and Steam for Actuating Engines;* Wm. Mt. Storm, City of New York.

Claim.—"Having specified my present invention, what I claim is, generating the steam for admixture with the air, or other gaseous body, in direct contact with the latter; the same, *i. e.*, the air or gas, not being the hot product of combustion, nor to arrive at the place of admixture from direct contact with any body of fuel undergoing combustion for the reasons explained. Further, I claim the plan of generating the steam for such said purpose, in some (comparatively as explained) dry vessel or heater for the reasons given; the water from which such steam is so generated being mainly held, while vaporizing, in suspension in the air, for the objects specified; and the air and water to that end being caused by some adequate means to meet with an extensive surface of mutual contact, as I have explained and shown."

12. For an *Improvement in Brakes for Railroad Cars;* George Frinks, Jersey City, N. J.

Claim.—"Having fully described the nature of my invention, what I claim therein as new is, the so combining the shoe frame with the ordinary truck or car, as that it may be raised and lowered by the operation of the brake lever, so as to be carried by the truck, or to receive the weight of the car, to aid in applying the brakes, and so that the wheels shall not come in contact with the shoes, but be free to turn, substantially as described. I also claim giving the truck or car a motion independent of the shoe, or brake frame, by means of the curved inclined planes, or their equivalents, on the shoe frame, up which the axles of the trucks may roll, by an easy swinging motion, whilst its entire weight continues to aid in applying the shoe or brake to the surface of the rails, substantially as herein described."

13. For an *Improvement in Stoves;* John J. Updegraff, Selins Grove, Pennsylvania.

"My improvements consist chiefly in arrangements of the parts of the stove, so as to combine an extensive radiating surface with an extensive air heating surface, or rather, to make the surfaces extensive; and also in other arrangements or combinations for the economy of heat, as will be hereinafter specified."

Claim.—"What I claim is, 1st, The combination of the central hot air passage, the annular fire chamber, and tubular fire pot, for the full economy of heat, as set forth. 2d, The combination of the outer casing, the tubular fire pot, and the central hot air passage, in the manner described, so that the currents from each may all unite and co-operate as set forth."

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 21, 1853.

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

Joseph P. Parke, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

Donations to the Library were received from The Royal Astronomical Society, and the Society of Arts, Manufactures, and Commerce, London; The Royal Irish Academy, Dublin; The Ecole Nationale des Mines, Paris; Chs. B. Stuart, Engineer in Chief U. S. Navy; Capt. M. C. Meigs, U. S. Engineer Corps; Hon. Joseph R. Chandler, U. S. Congress; The Bellefontaine and Indiana Railroad Co., Marion, Ohio; The South Carolina Institute, Charleston, S. C.; The Library Association of St. Louis, Missouri; Wm. Jackson, Esq., Newton, Mass.; The State Lunatic Asylum, Utica, New York; Prof. Martyn Paine, M. D., City of New York; G. H. Hart, Esq., Pennsylvania Legislature, and from Chas. Ellet, Jr., Esq., Civil Eng., Frederick Graff, Esq., Dr. B. Howard Rand, and Messrs. Birkinbine & Trotter, Philadelphia.

Donations to the Cabinet from Wm. W. Fleming, Esq., and Abiel Elliot, Esq., Philadelphia.

George W. Conarroe, Esq., presented a half length portrait of S. V. Merrick, President of the Institute, painted by the donor for the rooms of the Institute.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of March.

The Board of Managers and Standing Committees reported their minutes.

On motion, the Committee on Exhibitions were instructed to take the necessary steps to hold an Exhibition of American Manufactures next fall, agreeably to their recommendation this evening.

Resignations of membership in the Institute (3) were read and accepted.

New candidates for membership in the Institute (6) were proposed, and the candidates (3) proposed at the last meeting were duly elected.

On motion, a special vote of thanks to G. W. Conarroe, Esq., was passed for his valuable donation of a portrait of the President of the Institute.

Dr. Rand, Chairman of the Committee on Meetings, brought before the meeting a model of the U. S. Army wagon, for which he is indebted to Maj. Crossman, U. S. A. The wagons are made by Messrs. Wilson, Childs & Co., of this city. Dr. Rand read the following note from Maj. Crossman:

B. H. Rand, M. D.

My Dear Sir:—Agreeably to your request, I send you herewith, my model of the Army baggage wagons which I am now having manufactured in this City for the public service. Annexed is a description, in minute detail, of every part of these wagons, printed for use in the form of a contract, so that in the event of war, and a sudden need of a very large number of them, these printed descriptions can be distributed amongst the different manufacturers, to secure exact uniformity of construction in all respects. It is in the entire fulfilment of these conditions, by which every part of these wagons are made with the same exactitude of dimensions, (like the gun carriage of a park of artillery,) that the chief merit of my improvements for military purposes consists; for the same actual necessity exists for strict uniformity in the construction of all carriages used for the transportation of army supplies and material of war, as for a uniformity in the calibre of cannon and small arms, or the size of shot, shell, and fixed ammunition. The confusion and delay as well as the enormous expense incurred during the Black Hawk war, in 1832, the Creek and Seminole campaigns of 1836–37, and the war with Mexico, for the want of some fixed system of baggage wagons for the use of the army, induced me, long since, to turn my attention to this matter; and my location in this City, since the termination of the Mexican war, has enabled me by the aid of some of your excellent mechanics, and the sanction of my chief, General Jesup, Quartermaster General, to improve from time to time upon the old pattern, and to make such arrangements as at least to fulfil all the conditions required in the manufacture of these wagons, as well as at all times to secure a large supply of them in a very short time.

The coach tongue arrangement of the jaws of the front hounds, and the heavy iron bracing of them, as seen in the model, enables us by merely reversing the two iron plates at the mouth and throat of these hounds, to convert these carriages at once into ox wagons; although ordinarily they are intended to be drawn by six mules.

Every wagon is provided with an equipment of staples, mortises, and iron rings, in the lower frame pieces and fore holsters of the bodies, by which india rubber floats can be attached for the crossing rivers without unloading it; and when unloaded, the bodies of these wagons are so made as to be easily converted into boats capable of carrying across a river fifteen or twenty men each, by merely caulking the seams with a mixture of tallow, or any animal grease, or tar and wood ashes, or even using simple mud.

The weight of these wagons, complete, is 1780 pounds, which has been by some objected to as too heavy; but when it is considered that they are required for all kinds of service, including the carrying of shot and shells, and fixed ammunition, for an army, as well as its subsistence, forage, and clothing, and are compelled to travel over the roughest mountain regions, where no road has been marked out, as well upon the smooth, level prairie, whose general surface presents no obstacle, it will be seen that there is neither too much strength nor weight in these wagons for all kinds of work, and for every description of roads.

Since I came to this City in 1848, I have had manufactured here, altogether, nearly thirteen hundred baggage wagons, more than two-thirds of which have been of the improved model, now shown to you; and these have been sent to Texas, New Mexico, and California, and used constantly with the troops stationed there.

They have been used in transporting supplies of all kinds to our extreme frontier stations; and sometimes, when drawn by five yoke of oxen, have carried 4000 pounds more than eight hundred miles, over the roughest, stony, trackless desert, perhaps, in the world, lying between Lavacca Bay, on the Gulf of Mexico, and El Passo, on the Rio Grande; and I never yet heard of a break of any important part of them—never once of an axle or a wheel. I am, &c. G. H. CROSSMAN.

Philadelphia, 1*st April*, 1853.

Dr. Rand remarked that in the transportation of the clothing and equipage of the Army, an improved system of baleing had been recently introduced. The goods are packed at the general depot on the Schuylkill near Gray's Ferry. The bales are all of the uniform size of 3 feet long, 2 feet wide, and 18 inches deep, and are made entirely water proof. They have been tested by soaking in the Schuylkill for two days, as well as in cases of wrecks on the coast, and in the western rivers, without the contained goods being injured, in any case in which the baleing remained whole. From the uniform size of both wagons and bales, it can be immediately calculated how many wagons are required to transport a known quantity of stores.

Dr. Seth E. Winslow exhibited an improved fluid lamp, designed to prevent the necessity of frequently filling it. The base is made hollow to contain the burning fluid, which is supplied to the globe of the lamp through a tube reaching nearly to its top. When the fluid in the globe is nearly exhausted, more is supplied by simply inverting the lamp.

Dr. Winslow also exhibited a contrivance for moving a fan by the motion of an ordinary rocking chair.

A wooden case is attached to the back and to the hinder part of the rocker. Within this case is a rod moving vertically, projecting from the lower end of the case so as to touch the floor, and having at its upper end a cord passing around a pulley, into which is inserted the handle of the fan. When the chair is rocked, its backward movement forces up the rod, which is repelled by means of a spiral spring. Motion is thus given to the pulley, and consequently to the fan.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Deschamps' Improvements in Omnibus Registers.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "an Improvement in Omnibus Registers," invented by Mr. F. O. Deschamps, of Philadelphia, Pennsylvania—REPORT:

The instrument is placed in the front part of the omnibus, between the lamp and the hole by which the fare is passed up to the driver. It resembles in appearance the dial of a common clock with a single index.

It is the duty of the driver upon the receipt of each fare, to pull a handle, which rings a bell inside the instrument, and at the same time causes the index to move forward on the dial one division, while a similar record is made by a second dial, which is placed upon the same arbor as the centre wheel, and the hand or pointer, and is concealed behind the face of the first dial. When the index in the first dial, and consequently the second dial, have made an entire revolution, by means of a toothed wheel, notched cylinder and click, a second concealed dial is moved forward one division, corresponding in the instrument examined by the committee, to 36 divisions on the first dial. By this means any number of fares desired may be registered on the concealed dials. In the instrument examined by the Committee, the record exceeded 10,000.

The outer dial is examined by the agent at the terminus of the route at the end of each trip, the number of divisions passed over by the index noted, and the hand returned to zero. Each dial may be turned back without affecting the record upon that which enumerates the higher numbers.

The second and third dials are concealed behind the first, and their index numbers are brought into view by a key, in the possession of a second agent. This key slides back portions of the face or first dial, covering the indicating part of each; thus enabling them to be read, but not moved.

The concealed dials can only be reversed by means of a third key, which is in the hands of the proprietors alone. When they are exposed, the ringing apparatus is locked, and they cannot be moved forward.

Hence it may be seen that if the driver neglects to pull the bell, his dishonesty becomes apparent to all within the coach, among whom may be a secret agent of the proprietors, and the knowledge of this fact will tend to prevent any such attempt being made on his part.

The first agent who inspects the dial at the end of each trip, can only open the glass covering its face, and cannot expose the concealed dials. The second agent who inspects the concealed dials at the end of the day, cannot alter them, but acts as a check upon the driver and the first agent, while it is in the power of the proprietors to satisfy themselves, at any time, of the correctness of his records, by examining for themselves the concealed dials.

From a careful examination, the Committee is satisfied, that when the bell is once rung, it is impossible for the driver, agents, or any other persons, even when in possession of the first two keys, to prevent the record of the same coming to the knowledge of the proprietors, without their tampering with the instrument becoming evident.

As to the originality of Mr. Deschamps' improvements, the Committee has no positive testimony to offer. It is aware that register dials have been in use for years, in the English and French omnibuses. Mr. Deschamps claims the following improvements:

1. The use of the ratchet wheel and its pawl, or their equivalents, so arranged that it is impossible to ring the bell by a *recoil* of the hammer, and consequently each stroke must be recorded on the dials.

2. The combination of the toothed wheel, to which the dial plate is affixed, with the notched cylinder and the click, whereby the third dial plate is impelled one notch at each revolution of the second dial plate, thus registering on the concealed dials any number of fares registered in the visible dial plate.

In the French instrument examined by the Committee, the record did not extend above 34 figures. This instrument is portable, and managed by the conductor. It was shown to the Committee, that in it the bell may be rung by the recoil of the hammer, and no record consequently be made. It was also possible to alter the index, by means of a pick inserted in the key hole, which is not covered.

The Committee has no evidence that the improvements claimed by Mr. Deschamps have been before introduced.

The Committee believes that the general introduction of this instrument would not only benefit the owners of omnibuses, but would have a more extended effect. Without wishing to make a general or sweeping assertion against the characters of omnibus drivers as a class, it may be said that it is notorious, that under the existing arrangements, a large proportion of the fares paid by passengers does not reach the proprietors. The temptation to dishonesty held out is so great, that but few men, earning the low wages of omnibus drivers, could resist it. Even if a man sets out with the intention and desire to prove faithful to his employers, the example of others, the stimulus of necessity, the ease with which the abstraction may be made, and the small risk of detection, will often frustrate his good intentions. It is asserted, indeed, that the dishonest drivers will often combine against an honest one, and by means well known to those who have watched them, draw away his passengers, and thus make his daily payments to the proprietors less than their own.

The Committee believes that the introduction of this instrument, which renders fraud almost certain to be detected, will tend to elevate the character of the drivers as a class; while the increased receipts from the coaches will enable the proprietors to raise their wages in proportion.

In conclusion, the Committee considers the instrument of Mr. Deschamps as highly ingenious, and has no doubt that in practice it must prove a simple and effectual check upon the dishonesty of drivers and agents.

For the register exhibited at the last exhibition, and referred to this Committee, by the Committee on Exhibitions, it is recommended that a first premium be awarded by that Committee.

By order of the Committee.

Wm. Hamilton, *Actuary.*

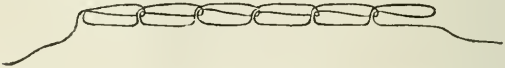
Philadelphia, March 10th, 1853.

Report on Sewing Machines.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "Improvements in Sewing Machines," invented by Messrs. J. P. Martin; I. M. Singer; and Odeon and Erling, of Philadelphia, Pennsylvania—Report:

An elaborate review of the whole subject of Sewing Machines, would require a degree of labor, to which we cannot now devote the requisite time; nevertheless, a careful examination of the matter has been made, because it is worthy of research, and all that can be done in promoting their application to the purposes of manufacture and domestic economy, will necessarily fall short of their recognised utility, in reducing manual labour, especially on the part of the sex whose welfare we are bound to protect and cherish. If this view needs enforcement, let him who doubts read the "Song of the Shirt;" if his feelings do not respond, he is unworthy of the name he bears or the form he wears.

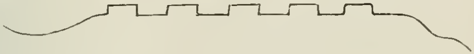
Our first step is to notice briefly the "stitches" which are produced by mechanical sewing. The "chain stitch" is probably the oldest of them, or more properly, that first employed, and has been so employed from a very early period. In the tambouring machine, it consists of a series of loops, of which the following diagram will serve as an illustration:



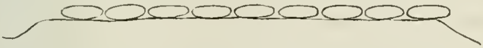
Most of the early sewing machines employed this stitch, and it is still employed, with propriety, for ornamental purposes; but it is not approved of, when strength or durability is required, as it will "run" if the thread breaks, and, as is evident on inspection of the diagram, may all be "run" out by drawing the end of the thread on the right.

The distinctive appellation, thread, is used throughout this report. It is intended to express the sewing material in its comprehensive sense, not confining it to its strict application to spun flax, usually called thread, but to all material, from the finest cotton and silk to twine, as employed in making seams by the sewing machine.

The next stitch in order of priority, comes under the denomination of "running." It is accomplished by means of a needle, with points at each end, and an eye in the middle. Its form is illustrated thus:



It has been extensively employed for the cheaper kinds of work, such as bags, &c., but cannot with propriety be applied to uses requiring durability, as it does not draw the work well together, and if a thread breaks, runs each way to a ruinous extent. The same machine it is evident could be made capable of sewing a "back stitch," thus,

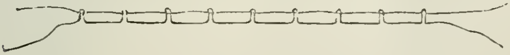


by means of an alternate backward feed, and would then imitate the stitch popularly known by the above title, and approved by seamstresses; but happily, the necessity has been superseded by the invention of a stitch greatly superior, to which we shall have occasion to refer at a future moment.

The needle with an eye in the centre, and double pointed, is beautifully employed in the embroidering machine, which dates back beyond the exhibition of arts and manufactures in Paris, in the years 1834 and 5, and worked upon cloth as many as sixty similar figures or flowers at the same time; the whole being directed by one hand, who by the aid of a pentagraphic guide on a prepared pattern, pointed the needles to their appropriate place of entrance, and return, with unerring certainty and exactitude.

We now come to the principle of the sewing machine, in its advanced state, or approaching to the perfect instrument; not that it is incapable of improvement, for perfection is a word which applies rarely in mechanics. We have no hesitation in saying, there is yet much to be done; we leave the development to time and experience, in the confident belief that opportunity and necessity will produce their fruit.

Our diagram will exhibit the stitch; it will be perceived at a glance



that two threads are employed. The lower one, or "wrong side" thread, being termed in the patent office report, of 1848, the "auxiliary thread," and is supplied or fed by a shuttle and bobbin; in this consists the peculiar principle of the best sewing machines, and in this, we may be allowed to observe, we believe their utility to consist, and to it may be attributed their superiority over all hand sewing. We may as well demonstrate this fact, before we proceed further with our report. Whenever a "needle full of thread" is employed, either by machine or hand, it is passed into the work with the needle, and drawn through until it closes up the seam, and this operation is repeated, stitch by stitch, until the "needlefull" is used up, and has been worn in exact proportion to the number of stitches taken, and must then be fastened off. It is then renewed, to undergo the same operation, the "fastening off" not unfrequently being carelessly done, the unequally worn and sometimes worn out thread being incapable of producing work bearing any comparison with the work of a machine, which wears only as much of thread as is necessary to make the stitch, and goes on without "fastening off" until the seam is finished, whether it be the "side seam" of a pair of pants, or the mainsail of a man of war.

Mention has been made of a patent for the use of two needles, one working horizontally, the other vertically. It is possible that another stitch is made by this machine, but as it has not fallen under our notice, and no specimen of its work has reached us, we cannot be expected to give any further notice of it.

Having, as we hope, given a brief but intelligible notice of stitches, and especially of that peculiar one employed, we proceed to describe the means by which it is effected.

The needle is secured in a stock, whose movement drives its point through the material to be sewed; the eye at a moderate distance from the point, carries the thread through, and then retires, leaving a loop, through which loop a shuttle is passed, on the under side of the material to be sewed; this shuttle carries a quantity of thread upon a spool, which it supplies as the seam progresses. The needle on retiring draws up the loop, and thus closes the seam, which on the upper or face side of the work, presents the appearance of what is called a "row of stitching," and on the under, a close resemblance, but differing slightly.

The return or rotation of the shuttle in its orbit, by the general movements of the machine, is a matter of course, and the work thus goes on continuously and with great rapidity.

The next subject of attention is the *feed*, or progressive movement of the material, which is accomplished by various means, generally, however, by the friction of a feeding wheel, whose roughened surface creates sufficient adhesion to move the material forward at the requisite intervals. This feed is effected by the ordinary means of a ratchet wheel and click or pawl, the latter capable of adjustment by shifting levers, so as to give a longer or shorter stitch, at the will of the operator or the requirements of the work.

Numerous patents are on record for sewing machines; an examination of their claims leads to the conclusion, that the peculiar and most valuable principle employed in them, that is to say, the employment of the double or auxiliary thread, is thrown open to the public use. We have some reason to suppose that it was employed as early as 1826.

Between the fourth of March, 1843, and April, 1850, there are seven patents; there are six in 1850, and four in 1851; how many subsequently we are not informed. Amid such a mass, it cannot be expected that we should sift the chaff from the wheat; their claims are principally for modification of parts, in seventeen or twenty varieties, and just such modifications as experience and peculiarities of application would suggest; we can report in approbation of those which have been submitted to inspection.

Mr. J. P. Martin calls the machine which he has submitted, "self regulating," and claims for it great advantages, in stopping when the thread breaks, or a loop is missed. We think that his claim is well founded; it must certainly be important to arrest the movement whenever such accidents happen. We think that a just analogy is inferred in this respect with the power loom, which would be of greatly reduced practical utility without that function. The means by which the machine is arrested in its movement by an accidental derangement of the thread, or the breaking of it, is ingenious in the highest degree.

The Committee in accordance with this view, recommend the Committee on Exhibitions to award to Mr. J. P. Martin a first premium.

The machine of Mr. Isaac M. Singer is certainly very successful and satisfactory in its operation, and capable of doing the best of work; the method of tightening the threads, and drawing in the seam, is averred to be an important improvement, in which estimation we coincide.

As Mr. Singer has received the award of a first premium, at the late Exhibition of the Institute, we cannot do more than express our approbation, and give our testimony, as to the propriety of that award.

By order of the Committee.

Wm. Hamilton, *Actuary.*

Philadelphia, March 10th, 1853.

Report on E. W. Bean's Zenith Instrument.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, the Zenith Instrument, invented by Mr. E. W. Bean, of Hatboro', Pennsylvania—Report:

That the invention consists in the employment of a telescope, so mounted as to be freely movable in a vertical plane, upon an axis which is itself kept vertical and capable of moving on pivots in a horizontal plane; thus giving to the telescope a motion in azimuth and altitude. Its motion in altitude is governed by a differential screw having a graduated head. The method of using it is to set the telescope upon a star as it passes the meridian, read its position by the graduation, and then direct it to another star, which passes the meridian later, by turning the differential screw by which the motion in altitude is governed. Should the second star pass the meridian on the opposite side of the zenith from the first, the vertical axis is turned upon its pivots through 180°, and the observation proceeded with as before. In this way, the difference of the zenith distances of two stars can be determined by easy manipulations, and the measurement by the differential screw can be read to a greater degree of accuracy than by the micrometer apparatus generally used for this purpose. In the explanation of the inventor, nothing is said of the method of insuring observations in the meridian, (since the instrument is capable of free movement in azimuth;) but this can be easily attained, either by meridian marks, established beforehand, or by following the star so as to get the observation of the least zenith distance.

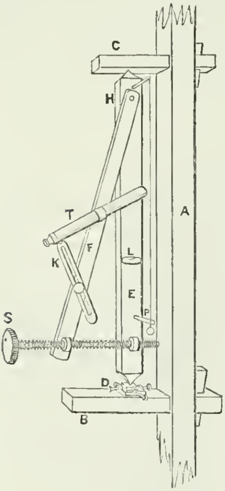
The Committee believe the proposal to use the differential screw for the purpose of accurately recording minute differences of altitude is new, and capable of useful application for practical purposes, and they recommend that a description of the instrument be published in the *Journal* of the Institute.

By order of the Committee.
WM. HAMILTON, *Actuary.*

Philadelphia, February 10, 1853.

MR. WM. HAMILTON, Actuary Franklin Institute.

RESPECTED FRIEND:—Will you please lay before a Committee of the Franklin Institute for examination, the following described instrument for determining difference of zenith distances, and thence the latitude of the place?



Let A be a post 8 or 10 feet, or more, as may be required, in which are inserted two arms, one near the bottom, B, and the other, C, near the top of the post, firmly secured by keys or braces. In the arm, C, insert the vertical axis, E, and at the bottom insert the axis, E, into a piece inserted into the screw box, D, capable of being adjusted to a vertical position by means of the 4 screws in the box, D, the verticality of the axis, E, being known by the level, L, attached thereto, or by the plummet, P, suspended from near the top of the axis, and coinciding with a mark or an index near P. To this vertical axis, E, is attached another, F, attached to the former near the top at H, as a centre. At the lower end of this is attached a differential screw, S, by a pivot nut corresponding with the coarser end of the screw; the other end of the differential screw being attached by a similar pivot nut to the vertical axis, E. To the axis, F, is applied the telescope, T, capable of being clamped in any position by the clamp, K. Now, to find the difference of zenith distances, (a value of one turn of the differential screw being known by experiment,) let the instrument be brought in adjustment with the axis, E, vertical either by the level, L, or plumb line, P; then bring the thread of the telescope to bear on a star either north or south of the zenith when passing the meridian. Now revolve the instrument on its axis, E, (it being capable of making a complete revolution,) so that the telescope may point to the meridian in the opposite side of the zenith, and observe a star passing the meridian by means of turning the differential screw until the thread of the telescope cuts the star; the number of turns of the differential screw will indicate the angular difference of the zenith distance of the two stars, one north and the other south of the zenith, supposing no change of refraction to take place during the interval of observing. Let this difference be called a. The sum of the zenith distances is the difference of polar distances of the two stars, which call b. Then $\frac{a+b}{2}$ will be the zenith distance of the star furthest from the zenith; and $\frac{a-b}{2}$ will be the zenith distance of the star nearest the zenith of the place of observation; whence the latitude is readily determined.

The value of a turn of the differential screw may be found by having the number of threads of each end of the screw to an inch, viz: multiply the number of threads to an inch in the coarser part of the screw by the number of threads to an inch in the finer part of the screw, and divide the product by the difference of threads to an inch in each part; the quotient will be the number of revolutions the differential screw makes to an inch. For example, suppose the one part of the screw has 20 and the other 30 threads to an inch, then $\frac{20 \times 30}{30-20} = \frac{600}{10} = 60$ revolutions the differential screw makes to an inch.

Again: take 25 and 30; then $\frac{25 \times 30}{30-25} = \frac{750}{5} = 150$ to an inch, and as the head of the differential screw may be divided, we may get a very exact reading of the distance moved over, or difference of zenith distances.

In order that the screw may not be too long to give greater differences of zenith distances, to extend the usefulness of the instrument, and multiply the observations, an arm may be inserted in the vertical axis, E, and another in the axis, F, one sliding over the other; one of them being graduated to $\frac{1}{10}$-inch, or parts of degrees, as may be desired, and a mark on the other to be brought to coincide with any of them, and then clamped; then for the rest of the difference of the zenith distance, the differential screw may be used. It is evident that other methods of finding a value of a revolution of the differential screw may be employed.

This method of obtaining the difference of zenith distances of the stars, I believe to be more exact than any other method I have known. The method of obtaining difference of zenith distances by a micrometer screw in the tube of the telescope, is certainly inferior in accuracy to this method, inasmuch as the readings of my method may be equally exact with the other, and the radius of motion being say 8 feet or more; while by the other method it is but the focal disk of the eye glass, say from 1 to 3 inches, or in proportion of say 96 to 1 or 3.

E. W. BEANS.

Hatboro', Montgomery Co., Penna., Nov. 23, 1852.

BIBLIOGRAPHICAL NOTICE.

The Mississippi and Ohio Rivers: containing plans for the Protection of the Delta from Inundation; and Investigations of the Practicability and Cost of Improving the Navigation of the Ohio and other Rivers by means of Reservoirs; with an Appendix on the Bars at the Mouths of the Mississippi. By CHARLES ELLET, JR., Civil Engineer. Philadelphia: Lippincott, Grambo & Co. 1853. 8 vo. pp. 367.

This book, which we look upon as certainly one of the most valuable contributions which has yet been made to Civil Engineering in this country, consists of two elaborate memoirs on the Mississippi and Ohio rivers. In the first of these, after a description of the general features of the Delta of the Mississippi and the character of the river, the author explains his views of the causes which have rendered the more recent floods upon this river so disastrous, and states clearly his reasons for believing that the destructive effects of these floods will continue to increase, so long as new levees reclaim lands which have heretofore afforded an outlet for the rising waters; and new cut-offs shall diminish the length, and thus increase the slope of the river. The effect of the rise of the bed he regards as but small, but leans to the opinion that the cultivation of the lands adjoining the river, diminishes the amount of evaporation, and facilitates the drainage, thus causing a larger proportion of the water which falls as rain upon the basin, to be discharged through the channel of the river. The remedies which he proposes are obvious, and with perhaps one exception, evidently judicious. They are, "better, higher, and stronger levees in lower Louisiana, and more efficient surveillance;" "the prevention of additional cut-offs;" "the formation of an outlet of the greatest attainable capacity from the Mississippi to the head of Lake Borgne;" "the enlargement of the Bayou Plaquemine;" "the enlargement of the channel of the Atchafalaya;" and "the creation of large artificial reservoirs, and the increase of the capacity of the lakes on the distant tributaries, so as to retain a portion of the water above, until the floods have subsided below."

It will be seen that Mr. Ellet has taken the most comprehensive view possible of his subject, and has treated it with great ability. In reference to the judiciousness of the remedies proposed, the most of them appear naturally indicated, practicable, and undoubtedly beneficial: we think, however, a strong argument might be maintained against the prevention of the cut-offs, and consequent shortening of the navigation of the river.

The memoir on the Ohio river is conceived in a similar spirit to that on the Mississippi, and treats at length and with great ability upon the proper mode for the improvement of the navigation of this river: a project, however, rendered perhaps of somewhat less importance than it formerly was, by the line of railroads which will soon skirt its borders.

In the brief leisure which we have had to examine this very interesting book, and meditate on its contents, we cannot pretend to express any final opinion upon the feasibility of the schemes which it contains, nor even to give to our readers an abstract of its contents; but we propose to return to it hereafter by extracts from the work itself, which contains much valuable statistical information, and we hope, also, by discussion of its theories and its projects, to which we invite the attention of that vast majority of our citizens who are interested in the improvement in the navigation of our rivers, and the increase of the productiveness of our South-Western States. F.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

JUNE, 1853.

CIVIL ENGINEERING.

Experimental Investigation of the Principles of Locomotive Boilers. By MR. D. K. CLARKE, EDINBRO'.*

(Proceedings of the Institution of Civil Engineers, London.)

March 8th, 1853.—The paper commenced with some historical facts in locomotive progress, showing that the general design of the locomotive was matured immediately after the trials on the Liverpool and Manchester Railway in 1829; combining the multitubular horizontal boiler, the horizontal cylinders, and the blast-pipe. Reference was made to the various systems practised in working out the general design, and to the necessity for fixed principles in proportioning the locomotive to the work for which it was destined. For the proper discussion of the question, it was indispensable to distinguish the three elements of the machine—the boiler, the engine, and the carriage; and to consider them separately, with respect to their proper functions, as the mixing up of one with the other had caused much of the confusion with which many of the recent discussions on the subject had been invested.

The paper was chiefly devoted to the discussion of the physiological principles of locomotive boilers. It was argued that the combustion of coke in the firebox was, in practice, very completely effected; that it was quite independent of the strength of the draft, being equally complete with fast and slow drafts; that expedients for improving the combustion were superfluous; and that the combustion of coal might also, in practice, be perfected by a judicious use of the ash pan, damper, and the fire door. The evaporation of 12 lbs. of water per pound of pure coke was found, by careful laboratory experiments, to be the maximum evaporative performance; in the best ordinary practice, an actual evaporation of 9 lbs. of water per pound of coke, or 75 per cent. of the possible maximum, was readily obtained, the balance being lost by leakage of air and by waste; and it was adopted by the author as the ordinary standard of practical economical evaporation.

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* From the London Artizan, April, 1853.

It was shown, by numerous examples, that the question of the relative value of firebox and tube surface was of no practical importance, as the efficiency of boilers was not sensibly affected by their relative amounts; that the superiority of firebox surface was due, merely, to its greater proximity to the fire; and that the distinction of radiant and communicated heat was merely circumstantial; that what was gained in radiant heat was lost in communicated heat; and that, whether it was all radiating, or all communicated, mattered not to the total efficiency of the fuel. On these grounds the author regarded with indifference the use of such expedients as extended fireboxes, midfeathers, corrugated plates, and combustion chambers; and it was asserted that, where the addition of midfeathers had been found advantageous, there had been a deficiency, or a mal-arrangement, of the tube surface.

A minute analysis was made of the results of numerous authenticated experiments on the evaporative power of locomotive boilers of very various proportions, comprising several made by the author on the engines of the Caledonian, Edinburgh, and Glasgow, and Glasgow and South-Western Railways. It was concluded, that the economical evaporative power of boilers was materially affected by the area of the fire grate, and by its ratio to the whole heating surface; that an enlargement of the grate had the effect of reducing the economical evaporative power, not necessarily affecting the quality of combustion in any way, but governing the absorbing power of the boiler, as the lower rate of combustion, per foot of grate, due to a large area, in burning the same total quantity of fuel per hour, was accompanied by a reduced intensity of combustion, and by a less rapid transmission of heat to the water; in consequence of which, a greater quantity of unabsorbed heat must escape by the chimney. An increase of heating surface, again, reduced the waste of heat, and promoted economy of fuel, and added greatly to the economical evaporative power. In short, the question resolved itself into the mutual adjustment of three elements—the necessary rate of evaporation, the grate area, and the heating surface, consistent with the economical generation of steam, at the assumed practical standard rate of 9 lbs. of water per pound of good coke. An investigation of the cases of economical evaporation in the table of experiments conducted the author to the following very important equation, expressing the relation of the three elements of boiler power; in which c was the maximum economical evaporation, in feet of water per foot of grate per hour; h was the total heating surface, in square feet, measured inside; and g was the grate area, in square feet:—

$$c = \cdot 00222 \frac{h^2}{g}$$

From this it followed:—1st, That the economical evaporative power decreased directly as the area of grate was increased, even while the heating surface remained the same. 2d, That it increased directly as the square of the heating surface, when the grate remained the same. 3d, That the necessary heating surface increased only as the square root of the economical evaporative power. 4th, That the heating surface must be increased as the square root of the grate area, for a given economical evaporative power. It was contended, thence, that the heating surface would be economically weakened by an extension of the grate, and would be strengthened by its reduction; and that, whereas large grates were commonly thought to be an unmixed good, and being generally recommended, were usually adopted, still they might be made too large; not that their extension affected the quality of combustion, but that the economical evaporative power might be reduced. Concentrated and rapid combustion was, alike, the true practice for the largest and the smallest boilers; and in locomotives, where lightness, compactness, and efficiency were primary objects, the boilers should be designed for the highest average rates of evaporation, per foot of grate, that might be followed in good practice, consistently with the highest average rate at which coke could be properly consumed; as, in this manner, the smallest grate, and the smallest amount of heating surface, consistent with good practice, might be employed. It was stated that 150 lbs. to 160 lbs. of good sound coke could be consumed per foot of grate per hour; and, allowing for inferior fuel, an average maximum of 112 lbs. per foot of grate per hour, was recommended as a general datum. This determined the average maximum of economical evaporation to be 16 feet of water per foot of grate per hour, allowing 9 lbs. of water per pound of coke; for which 85 feet of heating surface per foot of grate should be provided. It was accordingly recommended that a heating surface at least 85 times the grate area should be adopted in practice.

It was also shown, by examples of inferior economy of evaporation, that the clearance between the tubes, for the circulation of water and steam, was, in many boilers, much too small; that the clearance should be in proportion to the number of tubes, and that, for good practice, a clearance at the rate of $\frac{1}{8}$-inch for every 30 tubes should be allowed.

The author supplied several practical rules deduced from this examination, and stated his conviction, that the deductions from his experience with locomotive boilers were, in the main, applicable to all other forms of boiler. He applied the rules to several conspicuous examples of locomotive boilers of the present day, and endeavored to show in what respects they were defective; he also suggested simple means of rectifying them, and of improving their action, and alluded to the long boiler of Stephenson, as affording the best example of combined lightness, compactness, and evaporative power.

The author, finally, referred to his practical investigations on the subject of the blastpipe; from these he concluded that, in all practical cases, the blastpipe was susceptible, by a correct adjustment of the details of the boiler, of being made abundantly wide enough, consistently with the demands for steam, to afford a free and sufficient exhaust, at all speeds, so as practically to remove all back pressure by imperfect exhaustion.

15th and 22d.—The proceedings were commenced by an explanation of the diagrams exhibited, and by reference to examples, from the experience of Pambour and other experimentalists, in corroboration of the views propounded in the paper.

The author's deductions were admitted, as to the practical identity of fire box and tube surface, for evaporating action, and as to the constancy of the evaporative efficiency of fuel, whether by radiant or communicated heat, or both together, or whether the draft was mild or strong. It was considered that heat was specific and certain in its effects. Such expedients as "mid-feathers," &c., which were resorted to for specially increasing the firebox surface, were condemned, as they were considered to be no better than tubes, whilst, practically, they were inconvenient and costly; as, among other reasons, plates of $\frac{7}{16}$ths or $\frac{1}{2}$ inch in thickness were employed to do the work of the tubes, which were less than $\frac{1}{8}$th inch in thickness.

A practical rule, followed by some engineers, and stated to be founded on extensive experience, was to allow 5 feet of heating surface for 1 foot of water evaporated per hour, and 100 feet of evaporating surface per square foot of grate. Those results were found to agree with the maximum rates recommended in the paper. It was also argued, that the intensity of combustion materially affected the amount of heating surface necessary for economical evaporation, being less as the intensity was greater.

It was, on the other hand, contended, that the formula, as stated in the paper, would not apply to all engines; and the following table of actual results was given, showing the performance of various engines, several of which exhibited a greater and others a less evaporation of water and consumption of coke per square foot of grate surface per hour than the formula would have given:—

Actual Working Results of Engines, Compared with Deductions by the Formula.

Name or Number of Engine.	Total heating surface.	Total fire grate surface.	No. of carriages.	Speed per hour.	Actual evaporation per square foot per hour.	Evaporation by Clark's formula.	Actual coke consumption per square foot per hour.	Coke consumption by Clark's formula.	Per centage of difference in water.	Per centage of difference in coke.	Date, and name of observer.
234	1125	14·32	12·3	26.5	5·41	16·05	44·9	126·3	180	118	From March 10 to 12. inclu. Mr. Alexander.
291. 1st experim't.	1325·8	18·8	9	42·1	4·72	11·04	40·8	116·5	175	190	24 Feb., Mr. Forsyth.
291. 2d "	1325·8	18·8	17	38	5·12	11·04	58·43	102·7	120	76	7 Mar., Mr. Alexander.
300	1133·21	23·5	34	36·4	8·21	5·16	65·5	40·37	60	62	8 March. Mr. Forsyth,
Rocket—1st "	707	10·6	9	42·1	8·99	9·89	78·4	86·2	12	10	24 Feb., Mr. Alexander.
" 2d "	707	10·6	13	34·5	11·9	9·89	102·3	88·4	22	21	25 " " "
Heron and Prince of Wales.	707·54	10·6	34	34·5	10·68	9·89	72·1	73·7	11	10	8 March, " "

It was further argued that, from various causes, no formula could be framed to be of service, unless all the circumstances, in each case, were properly taken into account.

As an example of the objections to long tubes, the results were given of the work done by a luggage engine on the London and North Western Railway, before and after alteration. That engine originally had tubes 14 feet long, with a total surface of upward of 800 feet; the length of the tubes was diminished to 4 feet 9 inches, and the total surface was reduced to about 500 feet, when it was found that a saving in fuel of 40 per cent. per ton per mile moved was produced, with a saving of 23 per cent. per mile run; the coke used, per ton per mile, with long tubes, before alteration, being ·504 lb., and with the short tubes ·298 lb.

The back pressure was contended to be a serious drawback to the long tube engine, and an example was given of a trial of a single engine on the new plan, against two of the ordinary kind, with a load of 170 tons in both cases; and, although the single engine was 43 per cent. less powerful than the two engines together, and had 20 per cent. less heating surface, yet it had performed the same distance of 111 miles in ten minutes less time, and with 3 lbs. per mile less fuel. This, it was argued, was owing to the engine exerting a greater dynamic force, by being relieved from the back pressure of the blast pipe, which, in the case of the other two, was applied to force the fire and to draw the heated air through the long tubes.

(To be Continued.)

On the Use of Heated Air as a Motive Power. By MR. BENJAMIN CHEVERTON.*

(Proceedings of the Institution of Civil Engineers, London.)

The author, in a short historical notice, stated that Sir George Cayley had written on the subject in 1804 and 1807, and had subsequently built several engines, but that the Messrs. Stirling, of Scotland, produced the first really efficient engine, working by means of heated air, in the year 1827; in the same year Messrs. Parkinson and Crossley brought forward their air engine; that Mr. Ericsson, following more closely the arrangements and form of the ordinary steam engine, constructed an air, or a "Caloric engine," as it was termed, in 1833; Messrs. Stirling patented further improvements in 1840, and in 1845 their engine was described to and discussed at the Institution of Civil Engineers; in 1851 Mr. Ericsson brought forward his present form of engine;—and that the principle acted upon in both these latter inventions, and announced as an important discovery in motive mechanics, was the reiterated use of the same caloric, in the production of power. The mechanical means of realizing this idea were described, and it appeared that in both inventions they were substantially identical. The ejected hot air, by being brought into contact with an extensive metallic surface of wire gauze, was deprived of its heat, which the next moment was imparted to the incoming cold air, and thus the ultimate use of the furnace was only to supply the unavoidable waste of caloric by radiation.

This view of the subject was strongly contested, as being inconsistent with the best established laws of nature, and as involving the idea of the possibility of the creation of power. It was argued at some length, that the employment of caloric as a motive agent, consisted in the development from molecular forces of a dynamic force, and as such, was directly amenable to the third law of motion—that of action and reaction being equal and opposite. It was contended, that sensible caloric was not an indication of the presence, but of the abeyance of mechanical action; that these were interchangeably convertible quantities; and consequently, that a working force could appear, only as heat disappeared—a conclusion entirely opposed to the assumed principle of the "caloric engine," that "caloric could be made to operate over and over again." It was admitted, however, that there was an apparent anomaly in the application of the law of action and reaction, when caloric was in question, in the fact, that its quantity was not less after than before the generation of steam power, if it were estimated conjointly by water and temperature. But it was explained, that a cause might have two classes of effects, and might require two distinct and different measures, to indicate its entire efficiency; that while caloric might remain intact, under the aspect adverted to, it lost by a declination in the intensity of its temperature, for which the equivalent gain was a dynamic force—a conclusion as adverse as before to the idea that such force could be acquired without cost. It was, in short, in the aspect of a *vis viva* "force" in caloric, that the development of mechanical action must be considered. These views were further explained and illustrated, by a reference to the analogous difference between momentum and the more practical modification of power, named by Smeaton and Watt, "mechanical power," "work," and "duty;" and it was shown, that here also an apparent discrepancy existed in relation to the third law of motion, but which was cleared up when both the measures of power—that by time and that by space—were appropriately used.

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* From the London Repertory of Patent Inventions, March, 1853.

It was contended that the "caloric engine" was analogous to a non-expansive high pressure steam engine, which it would exceed in wastefulness of heat, if it were not provided with, what its inventer improperly termed, a "regenerator;" the office of which, it was insisted, was simply to absorb the unutilized sensible caloric of the escaping air, which, as compared with steam, was in very large proportion to the efficient caloric; and to afford another opportunity for its being converted into force, thus compensating for the loss of expansive pressure. An explanation founded on these considerations, was given of the continued action of the engine, for some time after the fire was withdrawn—a fact which had been advanced in support of, what was styled, the untenable hypothesis of a "regenerator of force."

Although the mechanical effect of heat might be proved to be independent of the chemical condition, if not also of the physical constitution of bodies, it was admitted that economy of fuel, as being a distinct question from that of economizing the caloric already in possession, was eminently a practical matter, only to be determined by experiment; and in this point of view it was explained, in what manner the reception of heat, at a much higher temperature than steam, was greatly in favor of air as a motive agent, but, on the other hand, many adverse considerations were adduced, tending to show the impracticability of the system in its present form.

In conclusion, it was shown, that the "Caloric Engine" did not rest on true principles, exclusively its own,—that its merits stood upon common ground with those of the steam engine; and, therefore, that, even should the performances of air be found superior to those of steam, it could not be anticipated that the former would immediately supersede the latter; but, as far as public statements could be relied on, the performances of the air engine on board the "caloric ship," *Ericsson*, were very unfavorable to the pretensions of the promulgators of the plan.

The discussion was commenced by an exposition of the several systems adopted by Sir G. Cayley, Stirling, Parkinson, and Crosley and Ericsson, illustrating them by diagrams; whence it appeared, that the most preferable mode of heating the air was that of Sir G. Cayley, by directly traversing the incandescent fuel; that the greater improvement recently introduced by Ericsson was the wire gauge regenerator, which, however, formed an integral part of Stirling's original design. The practical difficulties of the immense dimensions of the heating vessels and cylinders, and the rapid destruction of the metallic parts, were fully considered; and it was admitted that although, at present, there did not appear to be any positive recorded results, more advantageous than by the use of steam, it would be wrong to discourage the attempt to use heated air, and to overcome the inherent difficulties of the system.

Allusion was made to the appendix to a tract, published by Mr. A. Gordon, wherein it was shown that the volume of the gases into which one cubic foot of anthracite coal was decomposed, under atmospheric pressure, was 219,250 cubic feet; that the volume of air required to sustain combustion was 14,273 feet; the mechanical power developed was 473,000,000 lbs., raised one foot. It was proposed by Mr. Maxwell Lefroy to pass these gases through water, in order to purify them from grit, &c., and to cool them to a convenient temperature, and then to use them together with steam, in power cylinders. He proposed a system of co-axial cylinders, of which the central one was the furnace, the two next were cylindrical shell boilers, the water in the inner one of which completely covered the surface of the furnace, that in the outer one having its surface always below the insertion of the gas-pipes in the furnace; the exterior shells being for the purpose of gradually heating the air, in its passage to the furnace, so that the exterior shell, which alone sustained the bursting pressure, was always cool.

About one-seventeenth part of the power produced would be expended in forcing in the air required to sustain the combustion of the fuel. The coal-hopper was co-axial with the furnace, and was kept cool by the supply water descending through its hollow shell into the interior.

The system would be one of high pressure, and some of its advantages were assumed to be the absence of a funnel, saving three-fourths of the fuel, safety from explosion, with economy of first cost, space, and labor.

The construction of Ericsson's engine, and the application of the regenerator, were first described, and it was then argued, that the action of the regenerator almost amounted, theoretically, to the creation of force, and that it was not of the utility that had been presumed. From the best accounts, it appeared that various practical difficulties existed, in the application of heated air as a motive power, and from calculations which were entered into, it was shown, that the mean pressure of the air in the working cylinder being 4½ lbs., the engines making eleven strokes per minute, a total power was developed, which, after making a proper deduction for friction and waste, did not exceed 230 horse power with the cumbrous machinery which was described; it was then contended, that with such a fine model of a ship, and under the circumstances of the experiments, a greater speed than seven miles an hour ought to have been attained, with a less expenditure of fuel, and that, therefore, at present, the caloric engine could not be practically regarded as a successful innovation.

Tables and diagrams were exhibited, for the purpose of showing the relative amount of power obtainable from a given quantity of heat, applied in expanding air and in producing steam. From these it appeared that after taking into account all the conditions of each case, the useful effect would be nearly the same, independent of the regenerator, which, if not a fallacy, would turn the scale in favor of the use of heated air.

It was submitted by other speakers, that the machine involved a mechanical fallacy, as the regenerator produced no mechanical effect whatever. It might be granted, that the regenerator of Ericsson's engine received and re-delivered the heat, in the manner described, and that when the working piston was descending, the heat was deposited, and that when ascending, the heat was restored; but that operation could only result as a *consequence* of the motion of the piston, and not as a *cause* of its motion; hence no mechanical effort was made. This result was easily shown, by assuming the contents of the pump to be one, and the contents of the working cylinder to be two. If the working piston was at the bottom of the cylinder, and in equilibrium with the external atmosphere, as regarded the pressure on a unit of surface, and then began to move, and the air to be heated in its passage through the regenerator from thirty-two degrees to a temperature of 512 degrees, so as to double its volume, the lower piston would constantly produce a vacuity, so to speak, of two, to be constantly fed by a supply of one, from the pump, expanded into two, by the increase of temperature. Consequently the piston, at every instant of its motion, remained in equilibrium with the external atmosphere, and no mechanical effect could result. Still, in Ericsson's engine a mechanical effect had been produced; but then this mechanical effect was no greater than would be produced without the aid of the regenerator, by the simple action of the furnace itself, and not so economically as by the use of steam.

Further investigations were entered into of the theory of the air engine, and the general result appeared to exhibit so much distrust of the accounts already received of the working of the caloric ship, that it was suggested, that the further discussion of the subject should be adjourned for a few weeks, and meanwhile another paper was proposed to be written, so that the question could be more fully discussed on the next occasion.

An Account of a Deep-sea Sounding in 7706 fathoms, in 36° 49′ South Latitude, and 37° 6′ West Longitude. By Captain HENRY MANGLES DENHAM, R. N., F. R. S.*

This sounding was obtained on a calm day, October 30, 1852, in the course of the passage of H. M. ship *Herald*, from Rio de Janeiro to the Cape of Good Hope. The sounding-line was $\frac{1}{10}$th of an inch in diameter, laid into one length, and weighing, when dry, 1 lb. for every hundred fathoms. Captain Denham received from Commodore McKeever, of the U. States Navy, commanding the Congress Frigate, a present of 15,000 fathoms of this line, 10,000 fathoms on one reel, and 5000 on another; and considers it to have been admirably adapted for the purpose for which it was made and to which it was applied. The plummet weighed 9 lbs., and was 11·5 inches in length, and 1·7 inch in diameter. When 7706 fathoms had run off the reel, the sea-bottom was reached. Captain Denham states that Lieut. Hutcheson and himself, in separate boats, with their own hands, drew the plummet up 50 fathoms several times, and after it had renewed its decent, it stopped, on each occasion, abruptly at the original mark to a fathom, and would not take another turn off the reel. The velocity with which the line run out was as follows:—

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* From the London, Edinburgh, and Dublin Philos. Mag., March, 1853.

	h	m	s
The first 1000 fathoms in	0	27	15
1000 to 2000 fathoms in	0	39	40
2000 to 3000 fathoms in	0	48	10
3000 to 4000 fathoms in	1	13	39
4000 to 5000 fathoms in	1	27	06
5000 to 6000 fathoms in	1	45	25
6000 to 7000 fathoms in	1	49	15
7000 to 7706 fathoms in	1	14	15
	9	34	45

The whole time therefore taken by the plummet in descending through 7706 fathoms, or nearly 7·7 geographical miles of 60 to the degree, was 9h. 34m. 45s. The highest summits of the Himalaya, Dhawalagiri, and Kinchinginga, are little more than 28,000 feet, or 4·7 geographical miles above the sea. The sea-bottom has therefore depths greatly exceeding the elevation of the highest pinnacle above its surface.

The strength of the line tried before the sounding was found to be equal to bear 72 lbs. in air. The 7706 fathoms which ran out weighed, when dry, 77 lbs., exclusive of the plummet, 9 lbs. Great care was taken in the endeavor to bring the plummet again to the surface to show the nature of the bottom, but, whilst carefully reeling in, the line broke at 140 fathoms below the water-line, carrying away a Six's thermometer which had been bent on at 3000 fathoms.

The Economy of Water Power—McAdam's (Belfast) Turbine. By ROBERT DEMPSTER.*

The following rather extraordinary facts may be worthy of the attention of practical engineers and mercantile men. They relate to the results of some experiments made to find the useful effect produced by a turbine water wheel, lately erected here for Messrs. Richardson, Sons, & Owden, designed and made by Messrs. McAdam, of the Soho Foundry, Belfast. This establishment consists of a large spinning mill, and is driven by two steam engines, in connexion with the turbine referred to.

The steam engines are of themselves, quite able to drive the whole works, and their dimensions are—

Cylinder,	40 inches diameter.
Stroke,	7 feet.
Speed of piston,	336 feet per minute.
Area of piston,	1257 square inches nearly.

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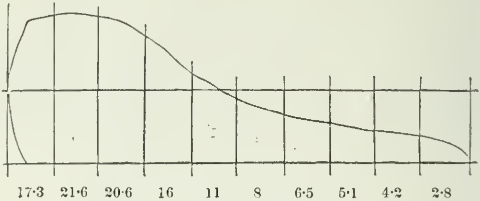
* From the London Practical Mechanic's Journal, April, 1853.

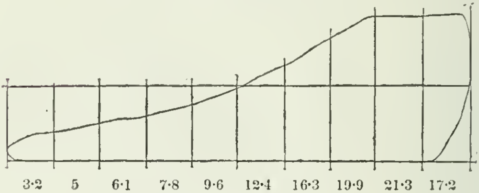
In order to arrive at the power of the turbine, the experiments were conducted in the following manner:—

Engine A, No. 1.—Turbine driven without water.



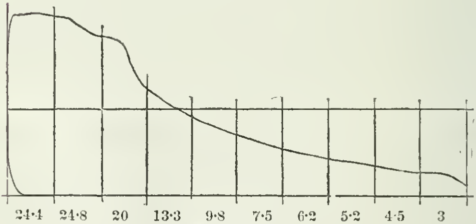
Mean, 11·31 lbs.

Engine A, No. 1.



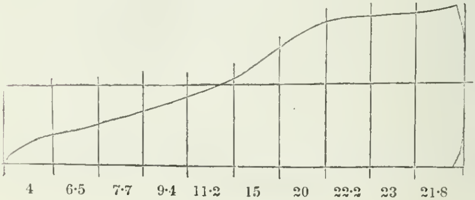
Mean, 11·88 lbs.

Engine B, No. 1.



Mean, 11·87 lbs.

Engine B, No. 1.



Mean, 14·08 lbs.

The water being shut off from the turbine, and the entire works driven by the engines at the regular speed, a set of diagrams (No. 1) were taken off the engines, and found to measure as under:

Engine A cylinder, top, . .	11·31 lbs.
" " bottom, . .	11·88 "
Engine B cylinder, top, . .	11·87 "
" " bottom, . .	14·08 "
	2)49·14

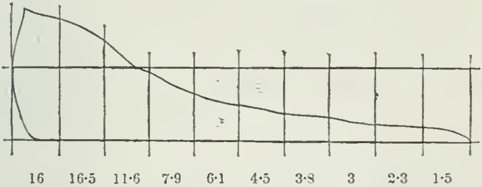
Equal to an average pressure on one cylinder of 24·57 lbs. per sq. inch; and the area of the cylinder being 1257 square inches, the absolute indicated horses' power of the engines will be

$$\frac{\overset{\text{Area.}}{1257} \times \overset{\text{Lbs.}}{24{\cdot}57} \times \overset{\text{Speeds.}}{336}}{33000} = 314\tfrac{1}{2}$$

horses' power nearly, to drive the whole works.

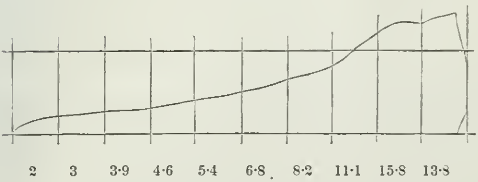
The next half of the experiment was made by allowing the water to flow through the wheel, and cutting off the steam, till the engines were driving at exactly the same speed as in the former half of the experiment, when a new set of diagrams (No. 2) were taken, which measure as under:

Engine A, No. 2.—Turbine with full water, 11⅛ inches deep.



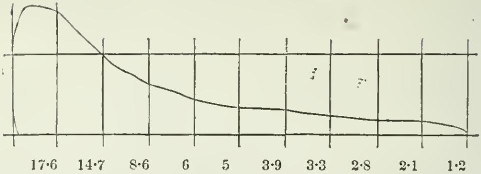
Mean, 7·32 lbs.

Engine A, No. 2.



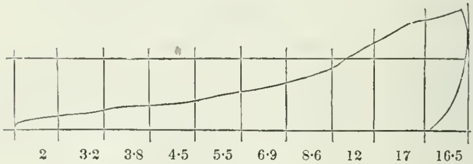
Mean, 7·46 lbs.

Engine B, No. 2.



Mean, 6·52 lbs.

Engine B, No. 2.



Mean, 8·00 lbs.

Engine A Cylinder,	top,	7·32 lbs.
" "	bottom,	7·46 "
Engine B cylinder,	top,	6·52 "
" "	bottom,	8·00 "
		2)29·30

Equal to an average pressure on one cylinder of 14·65 lbs. per sq. inch; and which reduced to horses' power will be $\frac{\overset{\text{Area.}}{1257} \times \overset{\text{Lbs.}}{14{\cdot}65} \times \overset{\text{Speed.}}{336}}{33000} = 187\tfrac{1}{2}$ horses' power nearly, exerted by the engines when aided by the turbine.

Now, 314½, minus 187½, leaves 127 horses' power as having been accomplished by the turbine; and if we suppose two horses' power to be equivalent to the extra friction of the engines when loaded, and one horses' power to drive the turbine without water, we still have 124 horses' power as having been given out by the turbine.

The Water consumed.—The water is derived from an artificial pond of large extent, in which the water is collected during the night, the top level generally sinking as the day advances. The greatest height of the fall is 48 feet, and at the time of making these experiments it was 47 feet. The quantity of water used was determined by rules founded on experiments made in Scotland some years ago, and which may be seen in any modern book treating of hydraulics.

The method of conducting the experiment is this:—In the tail-race there is a board fixed right across the race, and made water tight at the bottom and both ends. The water is made to flow over the upper edge of this board, and is confined at each side by perpendicular sides, which reach higher than the height of the overflowing water; the water, therefore, flows over what is called a rectangular notch; and, in the case before us, it was 100 inches wide, and the depth of the water, from the top of the board to the top of the water (at dead level), was 11$\frac{1}{8}$ inches.

By the rule above referred to, 11$\frac{1}{8}$ inches deep, and 100 inches wide, gives a discharge of 1580 cubic feet per minute; but from this must be deducted the condensing water from the engines, &c., which does not pass the turbine, amounting, by measurement, to 60 cubic feet per minute, thus leaving 1520 cubic feet, as having passed through the turbine per minute.

1520 cubic feet multiplied by 62$\frac{1}{2}$ lbs., (the weight of one cubic foot of water,) gives 95,000 lbs. falling through 47 feet, equal to $95{,}000 \times 47 = 4{,}465{,}000$ lbs., falling through one foot per minute; and this reduced to horses' power will be $\frac{4465000}{33000} = 135$ horses' power nearly, without making any allowance whatever for anything. Here, then, we have 135 as the absolute power of the water, and out of this we have 124 horses' power of useful effect. The per centage of effect will therefore stand $\frac{124 \times 100}{135} = 92$ per cent. of the absolute power of the water. 75 per cent. is considered a very fair result for the very best water wheels, but here we have at least 90 per cent. of the total weight of the water consumed; a result far better than anything I ever read or heard of before, and which, I think, is well worthy of the attention of all parties interested in the use of water as a motive power.

In conclusion, I may mention that the above (or similar) experiments have been made repeatedly with results varying but slightly from the above, and in every case the greatest care was exercised; and in order to guard against too hasty conclusions, there were full sets of experiments taken on different days, and also at different times on the same day.

Bessbrook, Newry, Ireland, March, 1853.

Receipts of French Railways.[*]

The receipts of French railways in 1852 are not yet known; but according to the returns published down to the 25th of December by the different Companies, they may be calculated to amount to 110,000,000f., being an increase of about 30,000,000f. as compared with the receipts of 1851.—*Times Paris Correspondent.*

Experiments on Portland Cement.[†]

We have received the following particulars of experiments on Portland cement, publicly made by Messrs. Aspdin, Ord & Co., on their premises in Abingdon street, Westminster, to which we willingly give insertion.

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[*] From Herapath's Journal, No. 710.

[†] From the London Builder, No. 525.

In previous volumes of the *Builder* will be found the particulars of various other experiments on the same material.

I.—EXPERIMENTS ON COMPRESSION.

No	Materials.	Size.		Tons	Results.
		In.	Thick.		
1	Neat cement, . . .	4 by 4	2 in	30 50	Cracked, Crushed, Flaw in casting.
*2	Neat cement, . . .	4 by $3\frac{1}{4}$	2	70	Crushed.
3	Neat cement, . . .	4 by 4	2	110	Crushed.
4	1 cement and 2 soft sand, .	4 by 4	3	40 60	Cracked. Crushed.
5	1 cement and 2 sand, . .	4 by 4	$2\frac{1}{2}$	30	Crushed.
6	1 cement and 3 sand, .	7 cube,		110	Not affected.
7	1 cement and 3 coarse shingle,	7 cube angles,		110	Not affected.
8	1 cement and 3 sand, .	7 cube,		110	Not affected.
9	1 cement and 3 sand, . .	7 cube,		110	Not affected.
10	1 cement and 4 sand, .	4 by 4	$3\frac{1}{2}$	40	Crushed.
11	1 cement and 6 shingle, .	4 by 4	$3\frac{1}{4}$	60	Broken.
12	1 felling stone, . .	7 cube,		110	Not affected.
13	1 felling stone, . . .	7 cube,		55	Not a fair test, defective plate.
14	1 felling stone, . .	4 by 4	$2\frac{1}{2}$	30 40	Cracked. Crushed.
15	1 cement and two stones,	7 cube,		70	One side flaked off, otherwise it remained unbroken at 110 tons.
16	1 cement and 2 hard burnt brick,	7 cube,		110	Not affected.

* The blocks were all made between the 8th and 12th of January, 1853, and were shipped, per steamer, from Newcastle in the beginning of February.

II.—EXPERIMENTS ON COHESION.

Block of neat cement, 12 inches long, $4\frac{1}{8}$ inches in thin part, 4 inches wide in shoulder, $2\frac{5}{8}$ inches in middle, and 3 inches thick, was pulled in two by 18 cwt. Defect in casting,—as immediately after, a block of same dimensions bore a weight of $31\frac{1}{2}$ cwt., when one of the flanches scaled off. On replacing the block, it bore 34 cwt., when the apparatus gave way.

One cement and three sand, same dimensions, bore $20\frac{1}{2}$ cwt.

Felling stone, $2\frac{1}{2}$ inches square in centre, pulled asunder by $6\frac{1}{2}$ cwt.

III.—CROSS STRAIN.

Neat cement, 12 inches long, $3\frac{1}{2}$ inches deep, $2\frac{1}{2}$ inches wide, and $9\frac{1}{2}$ inches in bearing, broke in the centre with a weight of 42 cwt. in the scales.

Felling stone, of same dimensions, broke with a weight of 10 cwt.

IV.—EXPERIMENTS ON ADHESIVE POWER.

Two blocks hard felling stone, each 13 inches long, 6 inches deep, $5\frac{1}{2}$ inches wide, cemented together with pure cement, bore a suspended weight of 3 tons, when the lower stone gave way near the joint, but not *through* it, the joint remaining undamaged.

Nine fire bricks, jointed with neat cement, were pulled asunder with $23\frac{1}{2}$ cwt. in the scales, the centre brick giving away, the cement joints remaining perfect.

Six fire bricks, jointed with 1 cement and 1 sand, 11¾ inch bearing, broke at the second brick from the bearing point, with 5½ cwt. suspended from the extreme end.

Ten fire bricks, 1 cement and 2 sand, 1 foot 7½ inches projection, bore 3 cwt.

A fire brick beam, 14 inches wide, 9 inches deep, 6 feet 4 inches between the bearings, jointed in neat cement, and weighted on a horizontal space of about 2 feet 4 inches in the centre, broke through the *bricks* in two places, with a weight of 20¾ cwt.

A fire brick beam, 14 inches wide, 10 inches deep, 5 feet 3 inches between the bearings, jointed in neat cement and weighted over a horizontal space of about 2 feet 4 inches in the centre, broke through the *bricks* in two places near the centre, with a weight of 30 cwt.

All the cement experimented on was mixed between the 8th and 12th January last.

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Increased Strength of Cast Iron, produced by the use of Improved Coke. By W. Fairbairn, M. Inst. C. E.*

Read before the Institution of Civil Engineers, March 1, 1853.

The paper commenced with a communication from Mr. Crace-Calvert on the subject of an improved system, of depriving the fuel, whether used in blast furnaces, or in re-melting cupolas, of the deleterious substances, by which the quality of the iron was deteriorated; or of the adaptation of the system to blast furnaces when using coal for smelting iron ores. The object was chiefly to point out what were believed to be the causes of the inferiority of iron in many works, apart from the varying qualities of the ores. These were stated to be the introduction and application of the hot blast, which had enabled the ironmaster to reduce into cast and malleable iron, a very large per centage of cinders, slag, and other impurities, containing large proportions of silicate of iron, sulphur, and phosphorus, all of which tended to destroy the tenacity of the metal, and to render it either "red short" or "cold short"—and also, when sufficient attention was not devoted, by those who were intrusted with the regulation and charging of the blast furnaces, to the chemical composition of the ironstone, by which the relative proportions of the flux and fuel employed in its reduction, should be regulated; the chemical composition of the limestone or the coal not being sufficiently known; these materials often varying in quality as much as the ironstone itself;—and the iron smelter was unable to tell, with certainty, the quality of iron which his furnace would produce;—instances had occurred, where a silicious ore had been used for three or four hours successively, and then at once it had been replaced by an aluminous and sometimes by a calcareous ironstone, without the change being made in the proportions of limestone, or coal, which was evidently required by the different qualities of those ores.

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* From the London Civil Engineer and Architect's Journal, April, 1853.

The following analysis exhibited the different quantities of silicium existing in cast-iron:

White-Crude.	Monkland.	Coltness.	Eglinton.	Dalmellington.
0·18	1·53	2·69	3·12	4·42

The injurious action which an impure fuel had upon the quality of the iron, was particularly alluded to; and the necessity of removing the sulphur from the coal or coke, when employed in the blast furnaces, before it could be imparted to the cast iron during the process of smelting, was strongly enforced. The difference in the quality of iron smelted with coal, and by the application of a process which had been recently introduced by Mr. Crace-Calvert, of Manchester, compared with iron smelted in the ordinary way, was exhibited in the following analysis:—

Proportions of Sulphur.

Eglinton Pig Iron.	Melted in the Cupola with ordinary Coke.	Melted with improved coke.
0·336	0·281	0·191

The following table showed the improved quality of iron after the application of the chloride of sodium in the blast furnace; by which the proportion of sulphur had been diminished:—

Monkland without chloride.	Monkland with chloride.	Dalmellington without chloride.	Dalmellington with chloride.
0·390	0·150	0·956	0·218

And the increased bearing weight of 1-inch bars cast from these irons:

579°	627°	487°	556°
576°	655°	456°	525°
—	—	487°	544°
—	—	470°	562°
—	—	—	569°

These improvements were described to have been effected at a very small cost, by the following simple process: If the blast furnace was worked entirely with coal, chloride of sodium was added with each charge, in proportion to the quality of the ore and flux employed; but a better result was produced, if the coal was previously converted into coke, and an excess of the chloride was used in its preparation, in order to act on the sulphur of the coal, and of the ore, should any be found therein; and a greater improvement was manifested in the quality of the iron when only coke so prepared was used in the blast furnace.

The coke, so purified, emitted no sulphurous fumes when taken out of the coke oven, nor, when extinguished with water, did it give off the unpleasant odor of sulphuretted hydrogen, nor was there any sulphurous acid gas liberated, during the operation of smelting iron in the cupola, or in raising steam in the locomotive boiler, by coke so prepared; and it was stated, that these decided advantages were gained in some cases at an additional cost of only one penny per ton of fuel.

The chemical action of the chloride of sodium was thus described: When coal was first subjected to heat in a coke oven, the bisulphuret of iron contained in the coal was decomposed into sulphur, which latter was distilled or burned, and also into proto-sulphuret of iron, which remained in the mass, and was acted upon by the chloride of sodium as it was volatilized at a red heat; thus chloride of iron and proto-sulphuret of sodium were produced. Then a second chemical reaction ensued: the proto-chloride of iron was decomposed into a sub-perchloride of iron, and the chlorine gas thus liberated reacted on the sulphuret of sodium, giving rise to chloride of sodium and to chloride of sulphur, which latter was disengaged—so that the prepared coke contained less sulphur than the ordinary coke; but admitting even that a small portion remained, it would be in the state of sulphuret of sodium, which would not yield any of its sulphur during combustion, but passsed into the cinders of the blast furnace, or of the cupola, and into the ashes of the firebox in the locomotive. Thus preventing the injurious effects of the sulphur on the fire bars and the copper of the firebox, and on the brass tubes of the boiler of the locomotive, and the sulphur thus fixed did not enter into combination with the iron, preventing crystallization during the process of smelting, and giving greater tenacity and closeness of texture both to the cast and to the malleable iron.

The second part of the paper gave the results of a series of experiments, which had been made by Mr. Fairbairn, upon trial bars one inch square, cast from iron melted in the cupola, with coke prepared by the process of Mr. Crace-Calvert, and exhibited specimens of the iron so prepared, when the closeness of texture and the absence of the 'honeycomb' appearance, prevailing in the iron cast with the ordinary coke, was clearly demonstrated. The mode of experimenting was described, and the results were given very elaborately, and it was shown that the average increase of strength was from 10 to 20 per cent.

Taking the mean of the whole experiments, the following conclusions were arrived at:—

	lbs.
The mean breaking weight of the bars per square inch, melted with the improved coke, was	515·5
Ditto Ditto with ordinary coke	427·0
	=88·5

in favour of the castings produced from the improved coke, or in the ratio of 5 : 4.

The experiments on the bars smelted with the improved coke indicated iron of a high order as to strength, and might be considered equal to the strongest cold blast iron; the metal appeared to have run exceedingly close, and exhibited a compact granulated structure, with a light gray color.

For the Journal of the Franklin Institute.

U. S. Screw Steamship Princeton. By B. F. Isherwood, Chief Engineer U. S. Navy.

In the winter of 1837, Captain John Ericsson applied his peculiar form of screw to a small boat called the *Novelty*, which was run on the canal between Manchester and London, England. The *Novelty* is *said* to have attained a speed of from 8 to 9 miles per hour; this was in the very infancy of screw propulsion, and the performance being witnessed by Capt. Robert F. Stockton, U. S. Navy, an energetic officer of talent and fortune, he was so struck with the peculiar adaptitude of the new system of propelling for war steamers, that he had a small iron steam vessel built, (called by his own name,) fitted with the screw, and sent to the United States. On returning thither himself, his representations to the U. States government resulted in an order to construct a screw war steamer of corvette size; Ericsson, who had also come to the United States, furnished the plans of the entire machinery, and the result was the *Princeton*. This vessel was commenced at the Philadelphia Navy Yard, in July, 1842, and was finished and sailed in fifteen months. In 1849 she was surveyed at the Charlestown Navy Yard, Massachusetts, and her hull, principally built of unseasoned white oak, treenailed, being found too much decayed for repairs, the machinery was taken out, and the vessel broken up. *All* the ship and steam logs of the *Princeton* having lately come into my hands, I have carefully prepared from them condensed tables of her performance, which, given with the dimensions of hull and machinery, and drawings of screws and boilers, will, I am persuaded, prove a valuable addition to our experimental knowledge of the action of the screw.

Amount of Cruising Performed by the Princeton.

The *Princeton* was ready for service, Oct. 16, 1843, and after the experimental trips on the coast, she

Sailed from Norfolk, Va., to Galveston, Texas, on special service,	April 27, 1845.
Arrived at Annapolis, Md., from Texas, . . .	July 3, 1845.
From Annapolis sailed to Philadelphia, and left latter port for Home Squadron, ...	July 25, 1845.
Arrived at Norfolk from the Home Squadron, . .	Dec. 3, 1845.
Sailed from Norfolk for Boston, ...	Dec. 13, 1845.
Arrived at Boston, ...	Dec. 19, 1845.
Sailed from Boston for the Home Squadron, . .	May 12, 1846.
Arrived at Philadelphia from the Home Squadron, .	April 19, 1847.
Sailed from Philadelphia for the Mediterranean, . .	July 23, 1847.
Arrived at Boston from the Mediterranean, . .	July 19, 1849.

Cost of the Princeton up to the date of first Sailing.

Engines and shafting, . . .	$ 60,402·46
Boilers, (first set,)	15,000·00
Appurtenances to boilers, except smoke chimney, .	3,000·00
Telescopic smoke chimney, with sliding tubes and machinery,	1,250·00
Ericsson screw, with two spare blades, . .	6,000·00
Coal bunkers, ...	1,835·75
Tools, duplicate pieces, engineer's stores, &c., .	4,165·70
Brass bilge pumps, ...	848·00
Hull and all equipments, ...	119,027·16
Total, . . .	211,529·07

Repairs of the Princeton, (Hull and Machinery.)

The *Princeton* was repaired at the following times and costs:

At New York, February and September, 1844, . .	$ 4,591·55
At Navy Yards, July and December, 1844, . .	4,497·51
At Philadelphia, December, 1844, and January, 1845, .	7,851·45
At Navy Yards, January and December, 1845, . .	3,515·48
At Boston, December, 1845, and May, 1846, . .	31,638·19
At Pensacola, July and October, 1846, . . .	5,319·35
At New York, April and May, 1847, . . .	2,508·10
At Philadelphia, April and July, 1847, . . .	39,405·38
Total repairs, . .	99,327·01

Or 8 1-6 per cent. per annum on the first cost.

But one alteration was made to the *Princeton*, and that was the substitution of the Stevens' for the Ericsson's screw, in March, 1845, at a cost of $9000. The cost of breaking up the vessel was $3145·34. These items added to the first cost, and to the repairs, makes the total cost of the vessel $323,001·77, from which must be deducted the value of the engines and shafting, (used in the new vessel of the same name,) and the value of the old iron boilers, and Stevens' bronze screw, and the bronze stern bearing, &c., (taken in part payment by contractors for new vessel,) amounting to about $33,000, leaving the cost of the *Princeton* to the government, $290,001·77. Duration of vessel from date of completion, five years and nine months.

Hull.—With *one-third* the water, provisions, and stores expended, the displacement is,	954 tons.
Corresponding to a mean draft of	16 feet 1½ inch.
Length of the load line from forward side of rabbet of stem, to aft side of rabbet of post at the above line,	153 feet 8½ inches.
Extreme breadth,	30 "
Depth of hold,	21 " 6 inches.
Depth from mean load line to lower edge of rabbet,	14 "
Displacement in cubic feet, exclusive of keel,	32,933
Disp't. in proportion to circumscribing parallelopipedon,	·525
Displacement in proportion to cylinder, having for base the floating line,	·262
Displacement in proportion to cylinder, having for base the greatest immersed transverse section,	·634
Centre of gravity of displacement before the middle of the length of the load line,	3 feet 11½ ins.
Centre of gravity of displacement below the mean load line,	5 " 4½ "
Area of mean load line,	3740·8 sq. feet.
" " " in proportion to circumscribing parallelogram,	·811
Centre of gravity of area of mean load line before the middle of the length,	2 feet 5½ inches.
Area of greatest immersed transverse section,	338 sq. feet.
" " " " in proportion to circumscribing parallelogram,	·804
Centre of gravity of area of greatest transverse section below mean load line,	8 feet 1¼ inch.
Distance of the greatest immersed transverse section before the middle of the length,	7 " 1¾ "
Height of meta centre above the centre of displacement,	7 "
Displacement per inch at the mean load line,	9·17 tons.
Launching weight of hull,	418 "

Rig.—

Surface of courses, topsails, topgallant sails, jib and spanker,	11,752 square feet.
Centre of effort before the centre of displacement,	3 feet 8⅝ inches.
" " above the mean load line,	53 " 3½ "
Surface of sail in proportion to area of mean load line,	3·14 to 1·00
" " " " greatest immersed transverse section,	34·92 to 1·00
Square feet of surface of sail in proportion to tons of displacement,	12·33 to 1·00

Position of the Centre of Gravity of the Ship.

In May, 1844, an experiment was made to determine the position of the centre of gravity of the ship, with the coal bunkers full, the boilers filled, and all the provisions, except 5000 gallons of water, on board, (which will lower the position below stated.) This experiment was made under the direction of Captain Stockton, and the *Princeton* is the only ship in the Navy in which this point has been determined. At the time of the experiment, the ship was at a draft of 18 feet 8 inches aft, and 15 feet 11 inches forward, in fresh water, and the centre of gravity of the mass was 12·9 feet above the rabbet of the keel. Much of the coal being stowed above this part, the stability will be increased to a certain extent as the coal is expended.

A peculiarity in the form of the *Princeton* is, that assuming the axis to be in the transverse plane passing through the centre of gravity, the centre of the forward part and of the after part are at equal distances from the said plane. This is only found in vessels of peculiar formation.

The *Princeton* was built under the absolute superintendence of Capt. Stockton. He had a carte blanche to construct the vessel in any manner, and with any machinery he thought proper. To him, therefore, is due the merit of having produced the best man-of-war steamship that ever floated; and his merit is not lessened from the fact that the vessel was designed by one of the ablest constructors in the country, and the machinery by an accomplished engineer; for a naval officer could not be expected to possess the technical knowledge required for the performance of these functions, but his good judgment and sagacity enabled him to combine the attainments of others for the successful accomplishment of the end he designed, and the knowledge of the subject required for the judicious selection of skilful agents, is only second to the knowledge required for the actual execution.

Armament.—During the time the *Princeton* was commanded by Commodore Stockton, she carried two 12-inch pivot paixhans, one forward, and the other amidships, with twelve 32 pounder carronades, mounted in broadside. After Commodore Stockton left her, the armament was reduced to one 8-inch pivot paixhan forward, and eight 32 pounder carronades in broadside.

Engines.—Two semi-cylindrical, direct acting, condensing engines, with rectangular pistons, vibrating through an arc of 90°. The engines are attached direct to the screw shaft, which makes one revolution to each double stroke of engine pistons. Each semi-cylinder is equivalent to an ordinary cylinder with a diameter of 57½ inches; stroke of piston, 3 feet; space displacement of both pistons per stroke, 108·19 cubic feet. The engines have a fixed slide cut-off valve, worked by an independent eccentric, and cutting off at one-third the stroke of piston from the commencement. The steam valve is the common three-ported slide.

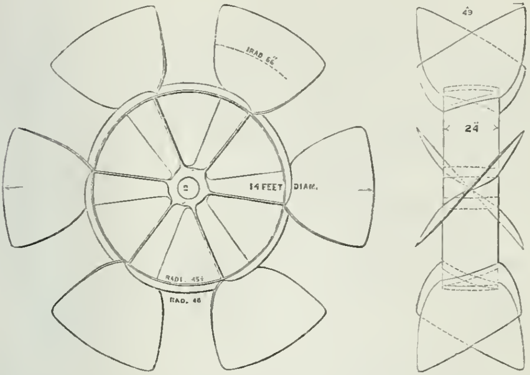
Area of steam port, . .	108 square inches.
" exhaust port, . . .	162 "
Steam space between cut-off and steam valves, one end of both cylinders,	3 cubic feet.
" " steam valves and pistons, one end of both cylinders,	10·36 "
Weight of engines, exclusive of screw propeller, *but inclusive of shafting, &c.,* . .	86·34 tons.

Coal Bunkers.—The coal bunkers are of iron, and weigh 6½ tons.

Screws.

Ericsson Screw.—The *Princeton* was originally fitted with the Ericsson screw, as shown in fig. 1. This screw was placed in the stern of the vessel, between the stern post and rudder post, and was composed of a bronze hub, arms, and drum, cast in one piece; on the drum were riveted 6 cast bronze arms. The screw was secured to the shaft (which was made tapering) by 6 long steel feathers, let half into the hub and half into the shaft, and by a strong steel key through hub and shaft, to back against.

Fig. 1.

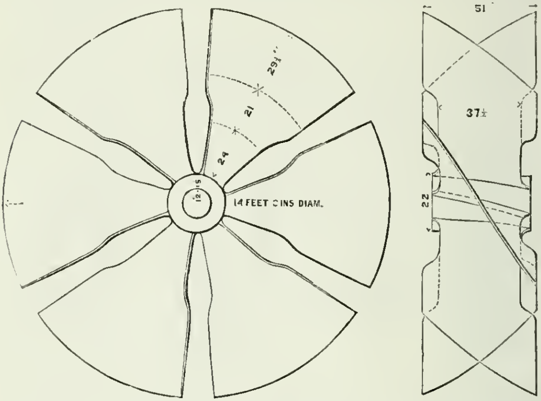


The thickness of the blades at the drum was only $1\frac{1}{2}$ inch. The proportions of the screw were those generally employed by Ericsson, viz: six arms inside and six blades outside the drum; the drum being placed at nearly half the distance from periphery of hub to periphery of screw. The arms and drum were of uniform length, measured on the axis of the screw, and the arms were equal in the aggregate to $\frac{343}{1000}$ the pitch. The blades overhang the drum, from which they curve out; they are equal in the aggregate to $\frac{7}{10}$-ths the pitch. The pitch is uniform for the entire screw surface, and is equal to $2\frac{1}{2}$ times the diameter of the screw. The following are the dimensions:

Diameter of hub,		1 foot 6 inches.
" drum,		8 feet.
" screw,		14 "
Number of arms,		6.
" blades,		6.
Length of the arms and drum in direction of axis,		2 feet.
" screw at 5 feet 6 inches radius in direction of axis,		4 " 1 inch.
" " periphery, " "		4 " 1 "
Pitch of the screw,		35 "
Angle of the blade at periphery from a line at right angles to axis,		38° 31′.
Helicoidal area of the 6 arms,	43·836 sq. ft.	
" 6 blades,	120·586 "	
Total helicoidal area of the screw,		163·422 sq. feet.
Projected area of 6 arms on a plane at right angles to axis,	16·634 "	
" 6 blades " " "	68·384 "	
Total projected area of screw on a plane at right angles to axis,		85·018 "
Mean fraction of pitch used,		.559
Weight of the screw,		12,000 pounds.

Stevens' Screw—Commodore Stockton becoming dissatisfied with the performance of the Ericsson screw, had it taken off at the Norfolk Navy Yard in March, 1845, and a screw (fig. 2.) designed by Stevens, of Hoboken, with the following dimensions, substituted for it. This screw was also of bronze, and of uniform pitch for the entire screw surface; thickness of blades at hub 4 inches. Each blade and the one-sixth part of the hub were cast in one piece, and the whole riveted together. This screw was secured on the shaft in the same manner as Ericsson's.

Fig. 2.



Diameter of hub,	1 foot 10 inches.
“ screw,	14 “ 3 “
Number of blades,	6.
Length of screw on hub in direction of axis,	3 feet 1½ “
“ “ at 3 feet radius in direction of axis,	3 “ 1½ “
“ “ at 4 ft. 9 in. “ “ “	4 “ 3 “
“ “ at periphery “ “	4 “ 3 “
Pitch of the screw,	32·44 feet.
Angle of blades at periphery from a line at right angles to axis,	35° 56′.
Helicoidal area of the 6 blades,	176·713 sq. feet.
Projected area of the 6 blades on a plane at “ “	113·517 “
Mean fraction of pitch used,	·724.
Weight of the screw,	15,970 pounds.

Experiment to test the relative efficiency of the Ericsson and Stevens Screws.

Ericsson Screw.—In order to compare the propelling values of the two screws, their performances were accurately ascertained in smooth water, by running the vessel forward and back over the same distance, making six runs in all with each screw, at a measured statute mile of 5280 feet, at Norfolk, Va. The Ericsson screw was experimented with on the 4th of March, 1845; the draft of the vessel being 15 feet 7 inches forward, and 18 feet 8 inches aft, or a mean draft of 17 feet 1½ inch. The course run was N. W. ½ W. and S. E. ½ E. The water was perfectly smooth, and there was a light breeze from the eastward; topgallant and royal yards crossed. The times given were taken on deck by a stop watch. The revolutions of the screw were counted in the engine room. The mile was run three times in each direction.

COURSE, N. W. ½ W.						COURSE, S. E. ½ E,					
Time of running each mile, in minutes and seconds.	Steam pressure in boiler in pounds per square inch above atmos.	Proportion of throttle open.	Steam cut-off at from commencement of stk. of piston.	Mean back press. in the two condensers in lbs. per square inch.	Number of revolutions of the screw made in running each mile.	Time of running each mile, in minutes and seconds.	Steam pressure in boiler in pounds per square inch above atmos.	Proportion of throttle open.	Steam cut-off at from commencement of stk. of piston.	Mean back press. in the two condensers in lbs. per square inch	Number of revolutions of the screw made in running each mile.
6′ 0″	17	½	⅓	1·7	174	5′ 7″	18	½	⅓	1·7	152
5 50	18	½	⅓	1·7	175	5 6	18	½	⅓	1·7	158
5 42	18	½	⅓	1·7	171	5 7	18	½	⅓	1·7	155

Total time of running 6 miles, 32 minutes and 52 seconds.

Total number of revolutions of the screw made in running 6 miles,	985
Speed of the vessel per hour in statute miles of 5280 feet,	10·95335
Revolutions of the screw per minute, . . .	29·9695
Slip of the screw in per centums of its speed, . .	8·107
Mean effective pressure per square inch of pistons, .	17·7 pounds.
Horses power developed by the engines, . .	500·893

Stevens' Screw.—The Ericsson screw having been removed and the Stevens' substituted, a trial was made with it March 22d, 1845, between the same points as with the Ericsson. The draft of the vessel, condition of rigging, &c., were the same as before; but the water was not quite as smooth, and there was a topgallant breeze from the westward. In this experiment the mile was not run three times in each direction, on account of vessels getting in the way; it was run *twice against* and *four times with* the wind. In calculating the results, however, I have corrected for this by averaging the mean of the two runs against the wind, with the mean of the four runs with the wind, and taking this average as the true performance uninfluenced by wind or current. After the trial, the Stevens' screw was permanently retained in the vessel.

COURSE, N. W. ½ W.						COURSE, S. E. ½ E.					
Time of running each mile, in minutes and seconds.	Steam pressure in boiler in pounds per sq. in. above atmosphere.	Proportion of throttle open.	Steam cut off at from commencement of stk. of piston.	Mean back pressure in the two condensers in pounds per sq. inch.	Number of revolutions of the screw made in running each mile.	Time of running each mile, in minutes and seconds.	Steam pressure in boilers in pounds per sq. inch above atmosphere.	Proportion of throttle open.	Steam cut-off at from commencement of stk. piston.	Mean back pressure in the two condensers in pounds per sq. inch.	Number of revolutions of the screw made in running each mile.
5′ 4″	18	⅓	⅓	1·45	182·4	5′ 0″	18	½	⅓	1·45	179
5 16	18	⅓	⅓	1·45	189·6	4 50	18	½	⅓	1·45	172
						4 48	18	½	⅓	1·45	167·5
						4 40	18	½	⅓	1·55	164·6

Average time of running one mile, . .	5 seconds.
Average number of rev's. of the screw made in running 1 mile,	178·388
Speed of the vessel per hour in statute miles of 5280 feet,	12
Revolutions of the screw per minute, . .	35·6776
Slip of the screw in per centums of its speed, .	8·760
Mean effective pressure per square inch of pistons, .	18 pounds.
Horses power developed by the engines, .	606·402

Comparison of the Results.—Taking the horses power developed by the engines as the expression for the powers, and the cubes of the speeds as the measure of their useful effects, we shall obtain the following results, viz:

	Powers.	Speeds.
Ericsson Screw, .	500·893 or 1·00000	$10{\cdot}95335^{3}$ or 1·00000
Stevens' Screw, .	606·502 or 1·21064	$12{\cdot}00000^{3}$ or 1·31473

$$\text{and}\frac{1{\cdot}31473}{1{\cdot}21064}=1{\cdot}086$$

That is to say, the Stevens screw was more economically efficient than the Ericsson in the proportion of 1·086 to 1·000. Now as the loss of useful effect by slip was in a slight degree greater with the Stevens than with the Ericsson screw, the economical superiority of the former must have arisen from its less friction on the water, owing to its greatly less surface, if the surface of the drum be included. I have been informed by the engineers on these occasions, that during the experiment with the Ericsson screw, one corner of one of the blades was considerably bent over by having previously struck some floating body; likewise, that the boilers foamed considerably, the consequences of which would be a lower cylinder pressure proportionally to the boiler pressure, and a greater load of injection water thrown upon the air pumps to maintain the same back pressure in the condensers, while the back pressure in the cylinder would be higher proportionally to the condenser back pressure. In the calculation of the powers developed by the engines in the experiments with the two screws, the same difference is taken between the boiler and cylinder pressures and between the condenser and cylinder back pressures. But even if a slight correction be made in favor of the Ericsson screw from these causes, there yet remains a decided difference in favor of the Stevens screw.

It will be observed that in the table of the performance with the Ericsson screw, the slip is much greater than in the tables of the performance with the Stevens screw; but in the former case the steaming was done on the northern United States coast in the winter months, and consequently in much heavier weather than in the latter case, where the steaming was principally done in the Mediterranean sea and Gulf of Mexico during the summer months, and very fine weather. In ordinary sea going weather the performance of the Stevens screw must have been somewhat superior, as its less pitch and greater diameter with greater length in axis, must have given less slip, and the omission of the drum less friction, as the area of its two sides was considerable, besides the resistance of its cutting edge. I am also of opinion that when in operation, the pitch of the Ericsson screw became really greater than it was when at rest, from the springing or yielding back of the front edge of the thin overhanging blade, which would have made the real slip greater than given in the tables.

The blades of the Stevens screw were heavier and stiffer, and their front edges better supported from the hub. The data of the foregoing experiment is taken from the official report, and is the only correct one I have seen.

(To be continued.)

For the Journal of the Franklin Institute.

Examination of Fusel Oil from Indian Corn and Rye. By CHARLES M. WETHERILL, Ph. D., M. D.

The researches of Guckelberger, Bopp, Keller, and others who obtained, by the fermentation and oxidation of nitrogenized substances, such as gluten, casein, &c., the successive members of the series of acids, $C_n H_n O_4$, rendered it probable that such a succession might be detected in fusel oil, by employing Liebig's method of isolating these acids, a method which enables small quantities of one of the group to be separated from larger quantities of the other members. It was also interesting to make an examination of fusel oil obtained from the fermentation of Indian corn.

With respect to the history of fusel oil: as is well known, Dumas obtained it first from the fermentation of potatoes; Balard showed that with this, the oil obtained from the fermentation of grapes was in its principal constituent (amylic alcohol) identical; and Medlock and Rowney showed the same to be the case with the fusel oil of the English and Scotch grain distilleries.

With regard to the acids present in fusel oil, Mulder detected œnanthic, Kolbe, margaric, and Rowney, capric acid. Medlock, who examined a grain fusel oil for an alcohol of one of the fatty acids, obtained nothing but alcohol, water, and amylic alcohol. Kent (*Am. Journ. Pharm.*, 1851, p. 354,) examined a specimen of fusel oil which contained acetic and valerianic acids, besides an ether, the acid of which was not isolated.

Wurtz (*Comptes Rendus*, xxxv, 310,) has recently isolated from potato fusel oil, butylic alcohol, boiling at 112° Cent.

In the subject of the present memoir, besides water and alcohol, formic (?),* acetic, caproic (?), œnanthic (?), and caprylic acids were detected, together with a small quantity of oil of turpentine, which probably proceeded from the barrel in which the substance was put, in the distillery, the proprietors of which were manufacturers of burning fluid.

The oil was obtained from the rectification of spirits made partly from rye, and partly from maize. It was neutral to test paper, of limpid, colorless appearance like alcohol, and of strong fusel smell. The volume was not much diminished by agitation with water; but the water when distilled gave alcohol. When distilled with a platinum wire, the thermometer rose gradually from 92° Centigrade to 226°, at which temperature there remained a small portion of dark colored oil. At first water and oil came over, and then oil alone. A considerable portion had passed over before the thermometer indicated the boiling point of amylic alcohol; but by successive rectifications, removing the water, the great bulk of the liquid had the boiling point of 132°.

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* The acids marked thus (?) were not obtained in sufficient quantity to obtain more than probably true analytical results.

The following are the proportions of distillate for such a first distillation:—

Boiling Point.	Fluid Ounces.
92°— 99° (2 layers)	4½
99 —109 (2 layers)	4½
109 —121	3¼
121 —130	4½
130 —134	16
134 —136	4½
136 —137	4½
137 —147	1¾
147 —168	2
168 —200 (yellowish)	½
200 —226 (yellowish)	½

There remained in the retort about ¾-oz. of a reddish brown liquid. When an alcoholic solution of caustic potassa was added to the members of this series, a bright yellow color was developed, which was deeper the higher the boiling point. After standing for some time, the liquids were shaken with water which was separated. They were then distilled, and the residue, which was dark and strongly alkaline, was washed several times with water; other portions of the fusel oil were distilled from aqueous and alcoholic solutions of potassa, and the alkaline liquids containing the fatty acids were united.

Examination of the Potassa Solution for Fatty Acids.—The potassa solutions obtained by uniting the alcoholic and aqueous solutions of potassa, were evaporated to dryness after several additions of water to expel the alcohol. They were then dissolved in water and decomposed in a retort, by dilute sulphuric acid, and distilled (with the addition of water) until it was supposed the fatty acids had passed over. The thumping of the retort, as the sulphate of potassa separated on concentration, was avoided partly by removing the crystals, and partly by using a ring gas burner made from a tube, and by which means the upper portion of the retort could be heated, while the bottom was kept in sand. A small portion of dark matter was left with the crystals and residue in the retort. This was tested for fatty acids (after neutralizing the free acid and separating the sulphate of potassa by alcohol,) by nitrate of silver; a very small quantity of whitish brown precipitate was obtained, which did not crystallize from boiling water.

The distillate containing the volatile fatty acids, consisted of an acid aqueous fluid, upon which floated drops of dark colored acid oil, of a peculiar rancid smell. A small portion of the aqueous fluid was neutralized by carbonate of soda, was added to the rest and distilled; nitrate of silver added to the solution of the residue in the retort caused a white precipitate, which immediately blackened on heating the test tube, indicating the presence of *formic acid*. The whole of the distillate was neutralized by carbonate of soda, and evaporated in vacuo; it crystallized in needles like acetate of soda. As the quantity was too small for an analysis, it was heated with sulphuric acid and alcohol in a test tube; the smell of acetic ether was distinct.

The fatty acids arising from decomposing the different potassa solutions were together in such small quantities (although a gallon and a half of fusel oil was employed,) that they were united. About ⅛-th was neutralized by $NaOCO_2$, added to the whole, and distilled. Another portion of the distillate resulting from this experiment, was treated in the same manner, and finally the whole. The soda salts thus resulting, I call 1, 2, and 3; they were not in large quantity. A drop of the solution of each evaporated upon a glass plate, was examined with the microscope.

No. 1 appeared in fibrous crystals converging towards the centre of the drop.

No. 2 appeared to consist of two different kinds of crystals, especially as seen by polarized light; one kind in one position of the plane of blue plumose crystals; and the other of white stellated prisms.

No. 3, evaporated at ordinary temperature, appeared in feathery stellated crystals.

In neutralizing the remainder of the liquid to prepare the salt, No. 3, as the fluid was approaching saturation, a peculiar motion was observed in the oil globules floating on the surface of the liquid; they were spasmodically agitated and repelled each other, moving quickly from side to side, very much as some animalculæ appear in the field of the microscope. It was not a rotation, or movement like that of camphor, or the butyrate of baryta on water, though doubtless proceeding from the same cause.

Fatty Acids in Nos. 1, 2, *and* 3.—The soda salt, No. 1, the residue in the retort after the first neutralization by carbonate of soda, was dissolved in water and nitrate of silver added, the precipitate was very slight; the solution concentrated in the water bath darkened very much. The residue after evaporation, yielded to boiling water, a small quantity of precipitate, insufficient for analysis, which separated on cooling. After evaporation once more in vacuo, over sulphuric acid, the residue evolved a strong smell of acetic acid when treated with sulphuric, and gave with sulphuric acid and alcohol, acetic ether.

The soda salt, No. 2, dried up over sulphuric acid in vacuo, to a gummy mass. On the addition of nitrate of silver to the solution, an abundant white precipitate fell, which was separated and redissolved in boiling water, from which the greater part was deposited on cooling. The remainder yielded but little to boiling water. I obtained enough of this precipitate to make two atomic weight determinations. It burned quietly and left a spongy mass of metallic silver, which left no residue on treatment with nitric acid. 0·11775 grammes of the salt gave 0·051 silver; and 0·128 gave 0·0555 silver, corresponding to a per centage of silver 43·26 and 43·35. Caprylate of silver requires by calculation 43·028. I had not sufficient of this salt for an organic analysis.

Soda salt, No. 3, which was slightly alkaline, was neutralized by nitric acid. The precipitate by nitrate of silver darkened slightly on boiling with water, with deposition of a small quantity of dark metallic silver on the capsule. A white curdy precipitate separated from the filtrate before cool, and on cooling, a further quantity of a slightly grayish precipitate. This latter precipitate which dried at 100° C., weighed 0·0335, gave on ignition, 0·016 Ag., or a per centage of 47·74. The silver salt of œnanthic acid contains 47·161 per cent. of silver.

The white precipitate which deposited before cooling, was dried at 100°, and was very electric; it gave the following analytical results: 0·12 grammes yielded 0·052 metallic silver, or 43·33 per cent., which agrees with caprylate of silver. I performed the organic analysis by combustion with oxide of copper. The results do not accord so well for caprylate of silver, the quantity at my disposal being almost too small for an accurate analysis of this salt; 0·1875 grammes gave CO_2 = 0·25575, and HO=0·1115, or a per centage as follows:—

	By Calculation.		
C_{16}	96	38·20	37·20
H_{15}	15	6·00	6·60
O_4	32	12·77	12·87
Ag.	108	43·03	43·33
	251	100·00	100·00

The filtrate from the first of these precipitations gave on evaporation in the water bath a residue, which yielded to a little boiling water a grayish salt, which precipitated on cooling. 0·027 of this gave 0·013 or 48·14 per cent. of silver. This would correspond to caproate of silver, which contains 48·43 Ag. The residue of oil of a portion of the fusel oil from which the above mentioned acids were separated, was treated with an additional portion of potassa, and the fatty salts separated from these aqueous solutions by chloride of sodium, and decomposed in a retort by sulphuric acid. The acids were boiled with baryta water, and filtered hot; a dark resinous substance was left on the filter. On cooling, a white flaky precipitate fell; carbonic acid passed through the filtrate from this precipitate, yielded a carbonate of baryta, from which scarcely anything could be obtained either by boiling water,* or by exhausting, when dry, with absolute alcohol.

The baryta salts of the fatty acids were in such small quantity that a separation and purification by crystallization was out of the question. They appear to consist of caprate and caprylate of baryta. This solution was evaporated in the water bath, removing the salt as soon as enough had separated to perform an atomic weight determination. The following is the result, premising that—

Œnanthylic	acid	requires BaO	per cent.,	= 38·44
Caprylic	"	"	"	36·20
Capric	"	"	"	31·94

The first salt that separated was in white imperfectly crystalline scales; 0·131 gave 0·0555 $BaOCO_2$, corresponding to 32·9 per cent. of baryta. In these crystallizations the salt separated, as a film on the surface of the liquid. The next salt, 0·53 gave $BaOCO_2$ = 0·252 or BaO p. c. = 36·92. The last crystallization gave 0·194 grammes of a salt which yielded 0·091 carbonate baryta, or 36·43 per cent. of baryta.

Examination of the Alcohols of Fusel Oil.—The portion of fusel oil from which the fatty acids had been separated, was washed with water, and submitted to a fractional distillation. At first oil came over together with an under layer of water, which was removed, and the different products of distillation dehydrated with carbonate of potassa, and with fused chloride of calcium. A considerable portion of chloride of calcium was taken in solution by that portion passing over between 87° and 100°, and which crystallized out on cooling, and after standing, in prisms or lengthened tables, similar to the compound of chloride of calcium and water. As these crystals had a peculiar smell from which they could not be freed by pressure between blotting paper, or by exposure to the air, and as they seemed less deliquescent than the ordinary crystallized salt with water, they were fused to determine the amount of volatile matter, in order to ascertain whether perhaps they were not a compound of amylic alcohol and chloride of calcium. The loss was 49·78 per cent., which corresponds to the chloride crystallized with six equivalents of water, or 49·28 per cent.

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* The boiling water gave, on cooling, 0·445 white precipitate, which contained 34·06 p. c. BaO.

After having dehydrated the portions collected between 81°—110°; 110°—132°; and 132°—136°, which last contained the great bulk of the oil, they were submitted to four rectifications, in which the following stadia were observed:

81°—84°—90°—100°—110°—120°—129°—132°—136° Cent.

The residue above 136° was not sufficient to cover the thermometer. In the second rectification, 81°—84° was collected at 81°—82°—84°.

During the fourth rectification, the thermometer still continued to rise from 81°—136°; but nearly the whole of the oil was collected at 132°—136°, and the thermometer was longer stationary between 81°—84° than at any intermediate stadium. They all, where not masked by the odor of the fusel oil, (as in the case of the higher ones,) smelled strongly of turpentine. The distillate between 81°—84° was rectified, and what passed over at 81° collected. Its density at 19° was 0·8194; and it presented the characteristic of alcohol contaminated with some foreign substance. After having stood for a day over freshly ignited charcoal, water was added, in which it nearly all dissolved, giving a milky fluid, from which a little oil separated. Water was now shaken with the several distillates up to 81°—119° inclusive. The quantity of distillate was very much reduced by the water, and the resulting oil smelled strongly of turpentine. These oils, separated from the aqueous solution, stood over night upon charcoal, and were kept boiling for some time over fused chloride of calcium, so that the vapors flowed back into the flask; they were then distilled, in a wax bath, from the salt. The quantity of oil thus obtained was quite small. The chloride of calcium when dissolved in water, set free a small quantity of oil of turpentine which was mechanically mixed with it.

Since the portion of oils passing at 120°—129° was the greatest in quantity after those already mentioned, I was desirous of forming the double sulphate, in order to ascertain by that means the presence of another alcohol besides amylic. I had three-fourths of a fluid ounce at my disposal, to which was added gradually an equal weight of oil of vitriol. After having stood for a few hours, there were two layers on the addition of water; the upper one a yellowish green oil, which diminished on the addition of more water. What remained undissolved, was in too small quantity for further examination; when rectified over carbonate of potassa, it began to boil at 115°, the boiling point at once rising. When suffered to evaporate upon the hand, it gave the smell of amylic alcohol and turpentine. The double sulphuric acid thus formed was neutralized by pure carbonate of baryta, and the baryta double salt, after evaporation to dryness in a water bath, was redissolved, filtered, and evaporated to crystallization. On cooling, crystals were obtained, which, under the microscope, and especially by polarized light, appeared as thin rhombic plates very much broken. I could not detect two different kinds of crystals. When dried for fifty hours in vacuo over sulphuric acid, these crystals presented the appearance of pearly scales, fatty to the touch. The mother waters gave a similar salt, and the mother water from these gave a small quantity of cauliflower-like crystals of the same appearance under the microscope; after having been dried in vacuo, their crystals blackened, and were decomposed when heated to 100° C.

The following is the amount of sulphate of baryta they contain, determined by incineration. They were difficult to burn, and after ignition they were moistened with a drop of sulphuric acid, and ignited a second time:—

0·6105 gave $BaOSO_3$ = 0·30325 = 49·67 per cent.
0·58525 " $BaOSO_3$ = 0·2895 = 49·47 "

Anhydrous sulpho-amylate of baryta contains 49·49 per cent. of sulphate of baryta.

Towards the close of this investigation, I met with Wurtz's paper on the occurrence of butylic alcohol in a fusel oil examined by him. I was therefore desirous of looking for this body in the fusel oil under examination. The oils left by adding water to the product, 81°—119°, after having been treated as described above, were in small quantity, and contained fusel oil, and oil of turpentine, besides a little water. They began to boil at a 105°, and were separated in two portions; those passing between 106°—110°, and those above 110°. These two portions were treated with sulphuric acid, and the baryta salts formed. Of these, only the liquid passing at 106°—110°, yielded enough for analysis, which was rendered uncertain by having unfortunately used for neutralization native carbonate of baryta which contained lime, and which was only discovered on examining the salts under the microscope, when the crystals of sulphate of lime were detected. The solutions were then evaporated to dryness, and exhausted with alcohol. The salts proceeding from the distillate above 110° yielded a small quantity of confusedly crystallized granules, not sufficient in quantity for analysis. The remaining portion gave a salt appearing in lance-shaped crystals under the microscope. The following is the analysis of the salt:—

1st Crystallization.—0·184 gave 0·07875 $BaOSO_2$ = 43·21 per cent.
2d " The mother waters yielded on concentration, 0·14675 of a salt which contained 0·06875 $BaOSO_3$ = 47·02 per cent.

Both of these sulphates of baryta contained a small portion of sulphate of lime. The following is the quantity of fixed sulphate in three of the vinic acids:

Sulpho-vinate,	Lime	Sulphate.	46·89
	Baryta.		60·23
Sulpho-amylate,	Lime	Sulphate.	36·36
	Baryta.		49·49
Sulpho-butylate,	Lime	Sulphate.	39·31
	Baryta.		52·62

It appears most probable that the salts analyzed were sulpho-amylate of baryta with a little lime, and possibly mingled with sulpho-vinates. I have not therefore been able to detect Wurtz's alcohol in the specimen of fusel oil for maize and rye. Different specimens of fusel oil appear to vary in the nature and quantity of their constituents. The specimen just examined contains but a very small quantity of the fatty acids.

Specification of a Patent granted to ALFRED VINCENT NEWTON, *of Middlesex, for Improvements in the Manufacture of Lenses,—being a Communication.*—Sealed 17th of April, enrolled October, 1852.*

The patentee commences his specification with the following explanatory remarks:—"The dioptric lens, heretofore and at the present time in use for sea-lights and for other lights requiring great intensity, being constructed of single zones or rings, made up of segments according to the diameter of the required lens, has induced a belief that glass could not be prepared without incurring the expense of grinding and polishing the curved surface; and that economy dictated a method of manufacture embracing a centre and zones or segments. The necessity daily shown for the more general application of a dioptric lens to the purpose of a sea-light, including, under that name, either revolving or stationary coast-light, bay-light, bar-light, ship signal-light, deck and between deck-light, port-light, and all other lights for ships, tide-light, floating-light, and coast, harbor, and river-light generally; and also of a land-light—including, under that name, railway locomotive-light, carriage-light, ferry-light, and as applied to architectural puposes, and, in fact, to any purpose where an intensity of light is required—induced the inventor to examine the method of construction of the "built-up lens," with a view, at least, to reduce the expense without diminishing the strength of the light. Commencing with the suggestions of Buffon, that a spherical body, from its thickness, absorbs light in proportion to its density, and that a sectional figure, of any required shape and thickness, could be cast of vitrified material or glass, and ground in steps or concentric zones to produce a lens (as executed with partial success by the Abbé Rochon), the present inventor considered that, from the expense incidental to the accuracy required in grinding and polishing the steps or zones, the lens of Buffon was beyond the reach of the million. The experiments of the Abbé Rochon, however, were useful in preparing the way for the manufacture of the dioptric lens in separate pieces, which was subsequently accomplished by the ingenious Fresnel, after the suggestions of Condorcet, producing the lens known as the "annular band lens," at the present time in use in several lighthouses, and in which the spherical aberrations are nearly corrected, by making the foci of each zone to coincide. Although of great utility, the enormous expense of making the annular band lens of Fresnel, (in which not only each separate piece must have its surfaces formed with great accuracy, but all the several pieces must be fitted to each other, so that, when put together, they shall constitute a perfect whole,) has limited the use of this otherwise valuable and desirable invention to a very few localities.

The object of this invention is to produce a dioptric lens, which shall present all the practical advantages of the annular band lens of Fresnel, and at so cheap a rate as to admit of its being applied to all purposes requiring intensity of light. And, to this end, the invention consists in a new manufacture of dioptric lenses, made in one or several pieces, moulded and pressed to the form required for the surfaces; and, when made in several pieces, the required fit of the several parts being produced by giving the reversed required form to the metal moulds in which the molten glass is to be put, and into and by which it is to be pressed.

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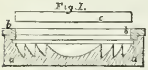
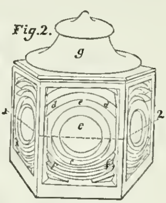
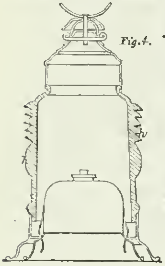
* From the London Journal of Arts and Sciences, January, 1853.

Fig. 1.







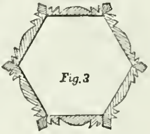


Fig. 1, represents, in vertical section, the apparatus employed for making a lens. *a*, is a circular mould, to receive the melted glass; *b*, is a follower, which rests on the mould; and *c*, is a plunger, that fits in the follower *b*, and is intended to spread the melted glass uniformly into the mould *a*, by pressure. This construction of mould, plunger, and follower, and the mode of using them, are well known to glass manufacturers. The mould may be made of any figure required; and the follower and plunger will be made to correspond with the mould. The mould *a*, instead of having the concentric central lens and rings, may present a plain surface; and the plunger *c*, may have on it the rings and figures shown in the mould *a*. The shape of the mould may be changed to any figure, whether convex or concave with the central zones or rings. The mould, instead of being made in one piece, may be made, sectionally, of as many separate rings or zones as there are designed to be rings or zones in the lens, or otherwise sectionally divided, according to convenience,—a suitable allowance in the diameter of each being made for the increased aggregate diameter, by reason of the parts being distinct; and, in such cases, the moulds for the separate rings and zones being laid together, and secured in their proper order, will form the entire mould; while the interstices, left between the separate pieces, will answer the same purpose as the holes at the angles of the zones, subsequently described, viz: to suffer the air to escape when the pressure is applied. If it should be desired (as it may be in the case of very large lights) to cast the lens itself in sections, the several sections may be moulded and pressed as described above, and then the whole cemented together in the usual way.

Fig. 2, shows, in perspective, a six-sided lantern; and fig. 3, is a transverse section of the same in the line 1, 2, of fig. 1. Each side of the lantern contains a lens, having a convex centre and several sections of zones or rings. This lens may be made in three pieces, *d*, *e*, *f*, which will require three separate moulds; or the whole may be cast together in one mould. Any required number of lenses may be combined together, after the manner shown at figs. 2 and 3. The cap *g*, of the lantern may vary in shape, and may be made of any suitable metal.

Fig. 4, is a vertical section of a hanging or hand-lantern, formed by fitting a stand, lamp, top, and ring, to a dioptric cylinder *h*, containing several zones or rings, of regular and irregular widths, which can be varied at pleasure, and may be manufactured of any length or circumference. If required, each lens may be made with one or many zones or concentric rings, according to the diameter,—the lens or segment of a lens being produced, as shown and described, by pressure in a mould, with or without "fire polishing." To promote focal intensity, and to prevent the absorption of light, it will be obvious that each lens should be manufactured as thin as the size and number of concavities and convexities will permit. It is not essential to lay down any rule for thickness, or for the size, as the intensity will be decreased by density; and therefore the thickness will be governed by the extent of surface required.

In the making of dioptric lenses, sharpness at the angles of the zones is of the utmost importance; and, to effect this object, it may be found necessary to form, in the angles of the mould, apertures (so small as to be nearly invisible to the naked eye) for the escape of air from the cavities of the mould; otherwise atmospheric air may be confined in such cavities: and, when pressure is applied, the air thus confined will prevent the glass from entering and assuming the required form of the sharp angles of the mould. When that part of the mould which forms the curved surfaces of the zones is made in sections, sufficient space can be left between the different zones for the escape of the air.

The patentee claims the manufacture of dioptric lenses of glass, in one or more pieces, by pressure in metallic moulds, substantially as specified.

On Soaps, and their Employment in Manufactures. By Professor F. C. Calvert.*

It may perhaps be desirable that, before I enter into the technical details contained in this paper, I should give a short outline of the manufacture of soaps, and of their chemical composition. The manufacture of soaps may be ranged under two great heads, the one relating to soft soaps, and the other to hard soaps. Both soaps contain fatty matter; but in the former case it is combined chiefly with potash, in the latter with soda. There is also another important difference between these two classes of soap, for soft soaps contain all the substances which composed the fatty matter employed in their preparation, whilst in the soda soaps one of these substances is removed, namely, the oxide of glyceryle, or glycerine. Thus, in the manufacture of soft soaps, either the fatty matters mixed with a large proportion of fish-oil, or the fish-oil itself, are boiled with caustic ley; and when saponification is effected, and the whole sufficiently concentrated, it is allowed to cool; while in the case of hard soaps, the caustic leys employed contain a sufficient amount of water to dissolve the glycerine as it is removed from the fatty matters by the action of the alkali contained in the caustic ley. From these facts it may be seen that the chemical change which takes place consists in the substitution of oxide of potassium or sodium for the oxide of glyceryle existing in the fatty matters in the state of a margarate, stearate, or oleate, and therefore in the formation of a margarate, stearate, or oleate of potash or soda, soluble in water. It is easy to understand that a great variety of soaps must be manufactured to suit the various purposes to which soaps are applied in domestic and manufacturing concerns; and so we find that different qualities of soap are manufactured for boiling silks, clearing wool, or for clearing madder goods, and giving to the different colors obtained from this root a greater brilliancy and fixity. Strange to say, we are quite ignorant of the real composition which each of these soaps should present to produce the maximum of effect, and we are even unacquainted with the composition of those now employed. I have therefore thought that it might be interesting if I were to offer a statement of the results I have obtained in connexion with this point. To arrive at a medium, showing the real difference which exists between soaps employed for the above purposes, I have been obliged to make a great number of analyses. This will be easily understood if we reflect that the quality of the soaps used by different parties, in a given trade, is so little examined, that even the soap used by a single firm varies as much as 25 per cent. in quality. The following general results I have however arrived at in calculating the composition of these soaps as containing 30 per cent. of water:—

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*From the London Chemical Gazette, No. 250.

Composition of Soaps per 1000 *parts.*

	Calico printers' soap.	Silk dyers' soap.	Wool scourers' soap.
Fatty matters, ...	640	619	614
Soda, ...	60	81	86
Water, ...	300	300	300

From these results we find that the soaps employed vary in the quantity of alkali according to the nature of their application; thus in 1000 parts of soap, there are 21 parts more alkali in the one used for boiling silk, and 26 parts more alkali in that employed for clearing wools, than there are in the soap best suited for clearing madder purples. These facts show us at once how important it is to inquire into the real composition of a soap before employing it for a given purpose. If, on the one hand, a calico printer were to use a soap which had the composition of the one used by the wool scourer, he would cause the shade of his madder purples to fade; and if, on the other hand, the wool scourer were to employ the neutral soap of the calico printer, he would have but imperfect results, owing to this circumstance, that in the latter case an excess of alkali is essential, not that the alkali may combine with the fatty matters of the wool, but that it may form an emulsion with the stearine and elaine discovered by M. Chevreul, and thus liberate the dirt which they fix on the wool. There is another point which deserves the serious attention of calico printers, and that is, the influence which soaps of different compositions must have on the different shades obtained in madder dyeing; for it must be obvious that the soap containing a slight excess of alkali, which is the best suited for clearing madder reds or dark pinks, would deteriorate the beauty of the madder purples. In the first case, the dyer has in view, not only to fix and brighten his reds or pinks, but further to remove the yellow coloring matter, and also partially the red; whilst in the latter a soap containing as little alkali as possible appears to me to give the best results. I have found by experiment the two following soaps to be best suited for these purposes:—

	Soap for purples.	Soap for dark pinks.
Fatty matter, ...	60·4	59·23
Soda, ...	5·6	6·77
Water, ...	34·0	34·00

Still we find that calico printers in general employ the same quality of soap for all shades of madder goods. Some dyers think that they overcome this difficulty by employing less or more of the same soap; but this is an error, not only as manifested by the above remarks, but because, as we shall show presently, the different soaps sold in the market, offer in their relative compositon differences which are equal to the different proportions they are in the habit of using for given styles or shades of madder prints. This fact can be easily proved by examining the qualities of soap which are supplied to a firm during a period of twelve months; for we find, as the following results show, that the quality of soap sometimes varies as much as 25 per cent. in value:—

	I.	II.	III.	IV.	V.
Water, ...	26·00	29·3	34·81	38·0	45·00
Fatty matter, ...	66·00	64·0	56·00	55·4	46·01
Alkalies, ...	7·56	6·3	6·98	6·1	5·80
Impurities, ...	0·43	0·4	2·21	0·5	2·19

The figures also show that the quantity of the real effective agent, viz: the fatty matter, in a soap may vary from 46 to 66 per cent.; consequently it may be seen that a large sum of money is wasted by some of our large

---

ving [illegible]
lmit the retort to be placed in a suita[illegible]
a gate afterwards inserted above the retort. By our mode of balanc-
he retort on the furnace or stove ends, the projecting ends and heads
e retort counterbalance the weight of the centre thereof, which here-
re has destroyed other apparatus by their sinking in the middle when
ened by the requisite heat to eliminate the gas profitably; there being
no connexion between the retort and the stove, there is no destruc-
of the latter from the expansion and contraction of the retort. By
form of the stove, and use of the additional section, damper, &c., there
great control and advantage in melting the resin with the waste heat
m the retort.
The form of the retort possesses the advantage of greater strength from
e vertical sides, which, with the flat floor, gives additional fire surface,
d as there is little coke or anthracite coal used as a distributing ma-
rial, this flat floor is very advantageous; the heads of the retort being
rovided with ground disks inserted in the bolted heads, the disks are
eadily removed, and inspection made of the working condition of the re-
ort, by withdrawing the clamp screw, thus avoiding the necessity of break-
ng the clay lute and removing bolts in the heads, to ascertain the working
condition of the apparatus.
The cleaning tap at the rear, affords by the introduction of an iron rod,
facility of removing obstructions in the outlet pipe, which is a descending
(instead of ascending) one, by forcing them down or up the outlet pipe;
the outlet being placed below the floor, prevents all the fluctuations of the

shades obtained from madder roots as a soap made with a vegetable oil composed of margarine and oleine; or with an animal fatty matter composed of margarine, stearine, and oleine; consequently if a dyer uses a soap of the former composition, it will prove, if not a direct loss to him, at least an injury to his goods, in disabling him from producing the maximum effect. I should also mention here, that I have found in print-works household soap of an inferior quality, and containing 10 per cent. and upwards of resins. These soaps have none of the properties required in calico printing, and must therefore prove a loss to the printer, as well as those soaps which are sometimes found to contain glue. I hope these facts will prove how highly desirable it is, that, with the existing competition both amongst our local firms and those of the continent, the indifference which exists as to the qualities of the drugs employed in print-works should cease, and that science united with practical knowledge [illegible] in and guide the application of chemical art in manufactures. [illegible] facturers progress in a sound and re-

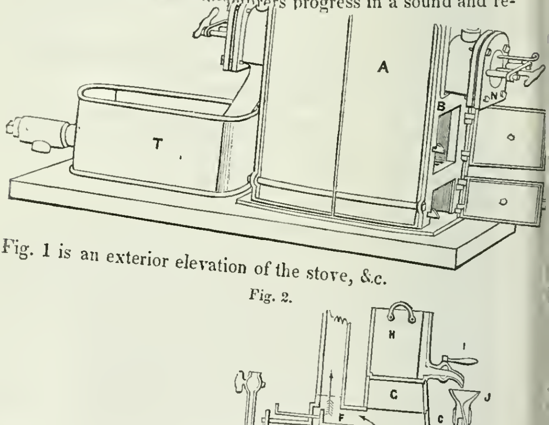

Fig. 1 is an exterior elevation of the stove, &c.

Fig. 2.

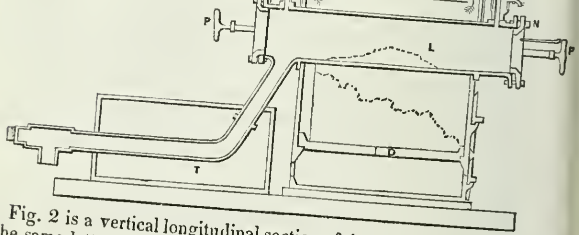

Fig. 2 is a vertical longitudinal section of the stove, retort, and cooler. The same letters refer to the same parts in each figure.

Fig. 1, A represents the side of the stove: B the ends: C gates in the ends: G is an additional section, placed under the resin holder, H, where the resin is melted: I is a stop cock: N, movable head screwed to the retort by bolts: T the cooler, supplied with water, covering the outlet pipe through which the gas passes down to the condenser.

Fig. 2, C represents gates in the ends: D, the grate bars: E, a plate near the top of the stove, to spread the heat to the ends of retort: F, a sliding damper, by which the heat may be thrown directly under the resin holder, or up the chimney: J, is a funnel and descending tube: K, an ascending tube rising from the front end of the retort, and extending an inch or two above the lower end of J: L, a retort of a D form, with the arch springing high from its sides, the bottom perfectly flat: P, P, clamps securing the ground heads of the retort: the rough lines under the retort represent the fuel: the lines in the retort represent the coke charging: the plug at the end of the outlet pipe can be removed, and an iron rod inserted, to remove any obstructions: the stop cock immediately over the outlet pipe is used to blow off gas when it is made too rapidly.

For the Journal of the Franklin Institute.

Remarks on the Indicator Diagrams of the Steamer "Magnolia." By S. H. Gilman, Esq.

To the Committee of Publications:

Gentlemen:—The steam gauges used on the steamer *Magnolia*, (the subject of my communication of Feb. 24th, p. 258,) were of the mercury compressed air variety, made by Borden, of New Orleans, and graded to the pressure of an open column of mercury, by which they were readjusted before leaving port on that trip. One was attached to the steam drum, (26 inches in diameter and 20 feet long,) laying transversely on the top of, and attached to all of the boilers; the other was attached to the steam pipe, three feet above the cylinder; there could not be any variation observed between the two. It is well known that on gauges of this description the index points for high pressures are exceedingly fine, and it is somewhat difficult to determine the exact pressure indicated. The indicator was verified by weights on its piston, and found to be correct, and was repeatedly examined to ascertain if the indicated vacuum was not due to some derangement; but the instrument was believed to be correct and in good order. After noting, with no little astonishment, the apparent identity of boiler and initial cylinder pressures on the first cards taken, they were observed with the utmost care, and if any difference existed between the two gauges, or the gauges and indicator, the instruments were not uniformly graded, which is quite possible. The great diameter of steam pipe and pressure of steam is, however, a great reason, and perhaps a sufficient one, why there should be no perceptible difference indicated by the gauges used; by a more sensitive gauge like the *æneroid*, a marked difference could probably be observed.

The anomaly of a vacuum in an exhaust steam pipe open to the atmosphere, has frequently been observed by the collapsing of such pipes when made of too thin copper, and especially when used for heating cane juice. A pipe, 5 inches in diameter and 240 feet long, open at the end to the atmosphere, and made of 20 pound copper, with the steam from a 15 inch cylinder, 5 feet stroke, exhausting through it, collapsed 60 feet of its length when cane juice of a temperature of 70° Fahr. was poured on it. Upon attaching an air pump to the same pipe, it required an atmospheric pressure of 20 inches of mercury to collapse a portion of the remaining piece. A safety valve pipe, 3 inches in diameter and 12 feet long, made of 18 pound copper, was observed to collapse upon closing the valve suddenly while steam was blowing off. It was observed when using the indicator on the *Magnolia*, that a medium initial cylinder pressure, with a full supply of cold water to the heaters, always produced a marked vacuum in the cylinders, while a maximum or minimum pressure of steam in the cylinders produced a less marked effect.

Respectfully, &c.

Cincinnati, April 18th, 1853.

Process for taking Photographic Landscapes on Paper. By Jno. Stewart, Esquire.*

Allow me to request your insertion in the *Athenæum* of the annexed communication, on the subject of Photography, in the form of a letter to myself from my brother-in-law, Mr. John Stewart, resident at Pau,—who has been singularly successful in his application of that art to the depiction of natural scenery,—and whose representations of the superb combinations of rock, mountain, forest, and water, which abound in the picturesque region of the Pyrenees, are among the most exquisite in their finish, and artistic in their general effect, of any specimens of that art which I have yet seen. The extreme simplicity of the process employed by him for the preparation of the paper, its uniformity, and the certainty attained in the production of its results, seem to render it well worthy of being generally known to travelers. It need hardly be mentioned that the 'air-pump' employed may be one of so simple a construction as to add very little to either the weight, bulk, or expense of the apparatus required for the practice of this art. The obtaining of a *very perfect* vacuum, for the imbibition of the paper, being a matter of little moment, a single barrel (worked by a cross handle by direct pull and push), furnished with a flexible connecting-pipe, and constructed so as to be capable of being clamped on the edge of a table, would satisfy every condition.

I remain, &c. J. F. W. Herschel.

32, Harley Street, Dec. 7.

My Dear Herschel,—Thanks to the valuable indications of Prof. Regnault, of the *Institut*, I have been enabled to produce, what appear to me, most satisfactory results in *Photographic Landscapes on Paper*. In this remote corner (so deficient also in resources for experiment) I feel that I am but very partially acquainted with the results obtained and the progress making in the great centres, Paris and London; but I think that, in detailing the simple process and manipulation I now adopt, indications of some value, and suggestive of further improvement to fellow-laborers in the art, may be found; and if you are of the same opinion, you will perhaps facilitate the communications of these details to our photographers at home.

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* From the London Athenæum, December, 1852.

The following observations are confined to negative paper processes, divisible into two—the *wet* and the *dry*. The solutions I employ for both these processes are indentical and are as follows:—

Solution of iodide of potassium, of the strength of 5 parts of iodide to 100 of pure water.

Solution of aceto-nitrate of silver, in the following proportions: 15 parts of nitrate of silver; 20 of glacial acetic acid; 150 of distilled water.

Solution of gallic acid, for developing a saturated solution.

Solution of hyposulphite of soda; of the strength of 1 part hypo. of soda to from 6 to 8 parts water.

The solutions employed are those reduced to their simplest possible expression, for it will be observed that in iodizing I employ neither rice-water, sugar of milk, fluorine, cyanure, nor free iodide, &c. &c.; but a simple solution of iodide of potassium (the *strength* of this solution is a question of considerable importance, not yet, I think, sufficiently investigated).

For both the wet and the dry processes I iodize my paper as follows: In a tray containing the above solution I plunge, one by one, as many sheets of paper (twenty, thirty, fifty, &c.,) as are likely to be required for some time. This is done in two or three minutes. I then roll up loosely the whole bundle of sheets, while in the bath; and picking up the roll by the ends, drop it into a cylindrical glass vessel with a foot to it, and pour the solution therein, enough to cover the roll completely (in case it should float up above the surface of the solution, a little piece of glass may be pushed down to rest across the roll of paper and prevent its rising). The vessel with the roll of paper is placed under the receiver of an air-pump and the air exhausted; this is accomplished in a very few minutes, and the paper may then be left five or six minutes in the vacuum. Should the glass be too high (the paper being in large sheets) to be inserted under a pneumatic pump receiver, a stiff lid lined with india rubber, with a valve in the centre communicating by a tube with a common direct-action air-pump, may be employed with equal success. After the paper is thus soaked *in vacuo* it is removed, and the roll dropped back into the tray with the solution, and then sheet by sheet picked off and hung up to dry, when, as with all other iodized paper, it will keep for an indefinite time.

I cannot say that I fully understand the rationale of the action of the air-pump, but several valuable advantages are obtained by its use:—1st, The paper is thoroughly iodized, and with an *equality* throughout that no amount of soaking procures, for no two sheets of paper are alike, or even one, perfect throughout in texture; and air bulbs are impossible. 2d, The operation is accomplished in a quarter of an hour, which generally employs one, two, or more hours. 3d, To this do I chiefly attribute the fact that my paper is never solarized even in the brightest sun; and that it will bear whatever amount of exposure is necessary for the deepest and most impenetrable shadows in the view, without injury to the bright lights.

Wet Process.—To begin with the *wet* process. Having prepared the above solution of aceto-nitrate of silver, float a sheet of the iodized paper upon the surface of this sensitive bath, leaving it there for about ten minutes. During this interval, having placed the glass or slate of your slider quite level, dip a sheet of *thick* clean white printing (unsized) paper in water, and lay it on the glass or slate as a wet lining to receive the sensitive sheet. An expert manipulator may then, removing the sensitive sheet from the bath, extend it (sensitive side uppermost) on this wet paper lining, without allowing any air globules to intervene. But it is difficult, and a very simple and most effectual mode of avoiding air globules, particularly in handling very large sheets, is as follows: Pour a thin layer of water (just sufficient not to flow over the sides) upon the lining paper, after you have extended it on your glass or slate, and then lay down your sensitive paper gently and by degrees, and floating as it were on this layer of water; and when extended, taking the glass and papers between the finger and thumb, by an upper corner, to prevent their slipping, tilt it gently to allow the interposed water to flow off by the bottom, which will leave the two sheets of paper adhering perfectly and closely, without the slightest chance of air-bubbles; it may then be left for a minute or two, standing upright in the same position, to allow every drop of water to escape; so that when laid flat again or placed in the slider none may return back and stain the paper. Of course, the sensitive side of the sheet is thus left exposed to the uninterrupted action of the lens, no protecting plate of glass being interposed,—and even in this dry and warm climate I find the humidity and the attendant sensitiveness fully preserved for a couple of hours.

To develope views thus taken, the ordinary saturated solution of gallic acid is employed, never requiring the addition of nitrate of silver; thus preserving the perfect purity and varied modulation of the tints. The fixing is accomplished as usual with hyposulphite of soda, and the negative finally waxed.

Dry Process.—In preparing sheets for use when *dry*, for traveling, &c., I have discarded the use of *previously waxed* paper,—thus getting rid of a troublesome operation,—and proceed as follows: Taking a sheet of my iodized paper, in place of floating it (as for the wet process) on the sensitive bath, I plunge it fairly into the bath, where it is left to soak for five or six minutes—then removing it, wash it for about twenty minutes, in a bath, or even two, of distilled water to remove the excess of nitrate of silver, and then hang it up to dry (in lieu of drying it with blotting paper). Paper thus prepared possesses a greater degree of sensitiveness than waxed paper, and preserves its sensitiveness not so long as waxed paper, but sufficiently long for all practical purposes, say thirty hours, and even more. The English manufactured paper is far superior for this purpose to the French. To develope these views, a few drops of the solution of nitrate of silver are required in the gallic acid bath. They are then finally fixed and waxed as usual.

These processes appear to me to be reduced to nearly as great a degree of simplicity as possible. I am never troubled with stains or spots, and there is a regularity and certainty in the results that are very satisfactory. You will have observed, too, how perfectly the aerial perspective and gradation of tints are preserved—as also how well the deepest shadows are penetrated and developed—speaking, in fact, as they do to the eye itself in nature. In exposing for landscape, I throw aside all consideration of the bright lights, and limit the time with reference entirely to the dark and feebly-lighted parts of the view; with a $3\frac{1}{4}$-inch lens; the time of exposure has thus varied from ten minutes to an hour and a half, and the action appears to me never to have ceased.

The influence of the air-pump in this appears to me very sensible, and deserving of further examination and extension. I purpose not only iodizing, but rendering the paper sensitive with the action of the air-pump, by perhaps suspending the sheet after immersion in the nitrate bath under the receiver of the air-pump for a few minutes, before exposure in the camera, or by some other manœuvre having the same object in view.

I should add, that I have chiefly employed Canson's French paper in iodizing with the aid of the pump. Few of the English manufactured papers are sufficiently tenacious in their sizing to resist the action of the pump, but they may easily be made so; and were, in short, the English paper so far superior in quality to the French, only better sized, that is with glue less easily soluble, even though more *impure*, there is scarcely any limit to the beauty of the views that might be produced.

There are more minor details that might be given; but I fear repeating many a "twice-told tale," acquainted so little as I am with what is doing; the preceding, however, may have some interest, and whatever is of value is entirely due to our friend M. Regnault, ever so generously ready as well as able to aid and encourage one's efforts.

Ever yours, JOHN STEWART.

Pau, Pyrenees.

Translated for the Journal of the Franklin Institute.

Note on Two Modifications of Bunsen's Battery; of which the one Augments the Internal Conductibility, and the other the Tension. By MM. LIAIS and FLEURY.

When the diaphragm of a Bunsen's battery is suppressed, the carbon being porous and impregnated with nitric acid, the internal conductibility of the pile is increased five-fold; which, according to the laws of electric currents, amounts to a similar increase of surface without increase of expense. We have shown this fact by the following experiment: An element thus modified caused an electro-magnet to support 58 killogrammes. To support the same weight by increasing the surface of the old pile, it was necessary to connect five Bunsen elements by their similar poles, so as to form one element of five times the surface.

To keep the porous carbon impregnated with nitric acid, we employed the following arrangement: A glass cylinder surrounds the carbon so as to keep an annular cavity between them, which is filled with nitric acid. Clay or cement fastens the two cylinders together at their lower ends. When the carbon is inside the pile, a cavity may be drilled in it. By introducing in the preceding battery of carbon impregnated with nitric acid, a diaphragm, and charging on the carbon side with concentrated sulphuric acid, and on the zinc side with dilute acid as usual, the conductibility of the battery is almost the same as in the Bunsen battery, but the tension is nearly doubled.

If, instead of causing, by means of a single diaphragm, the concentrated sulphuric acid to act directly on the acid at 12°, several diaphragms are interposed so as to enable the concentrated acid to act on an acid less concentrated, and so on by degrees to the acid of 12° in which the zinc is plunged, it will be found that there is a considerable increase of tension, but we have not as yet measured it exactly.

One element of this latter battery behaves like a Bunsen battery of several elements, and costs much less.—*Comptes Rendus de l'Academie des Sciences de Paris, 29th Nov.*, 1852, *p.* 802.

For the Journal of the Franklin Institute.

The Caloric Engine and the "Mechanic."

In the *Mechanic* (New York) of March 5th (No. 21, vol. II,) is the following article, which has just come to my notice:—

> "*Erroneous Estimates, in the Journal of the Franklin Institute, upon the Caloric Engine.*"
>
> "We have noticed in the February number of the *Franklin Journal*, a comparative estimate upon the caloric and steam engine, which figures out a saving of 51 per cent. for the caloric engine, while in reality it can be shown, even by the same figures, that the saving does not amount to 25 per cent.; and further, if the proper elements were introduced, the results would turn in favor of steam.
>
> "It is very much to be regretted that such an important error should have been allowed a place in the only scientific journal which we now have in this country, and the only one which is considered reliable authority.
>
> "We give below the section of the article referred to."

Then, after quoting from the *Journal of the Franklin Institute*, the calculations referred to, which are on page 126, he proceeds to make the following remarks:—

> "In this estimate, Articles 1st and 2d are correct. Article 3d should read—16 lbs. cut off at one-third gives 11¼ lbs. mean effective pressure; which, added to 12½, gives 23·75 lbs. effective pressure.
>
> Eight pounds pressure of air cut-off two-thirds, gives 7·5 lbs. mean effective pressure.
>
> Then, $\frac{23{\cdot}75}{7{\cdot}5}=3{\cdot}16$, which gives $2\times3\times3{\cdot}16=19$ nearly. Then, $\frac{3696}{19}=194$.
>
> Cutting-off one-third gives $\frac{194\times2}{3}=128\times60\times10{\cdot}5=80640$.
>
> $\frac{80640}{853}=94\times62{\cdot}5=\frac{5875}{7{\cdot}5}=783$; the caloric being 550. But it is stated on good authority that, had the *time* been correctly given, the consumption would have been 800 lbs. per hour."

Before the editor of the *Mechanic* endeavored to criticise statements made in a journal respecting which he holds such flattering language, he should have been careful to assure himself that he understood the principles on which they were based.

The mode of ascertaining the average pressure of steam in a cylinder with a given cut-off is not as he supposes it to be in his "corrected calculation," viz: applying the co-efficient to the initial pressure *above the atmosphere*, and then adding the vacuum to the result; but to apply the coefficient to the *total* initial pressure, and deduct from the result the back pressure constantly opposed to the piston by the vapor in the condenser. Thus, 16 lbs. per sq. in. being the initial pressure (above the atmosphere), and 14·7 that of the atmosphere in round numbers, a vacuum of 12·5 lbs. by the gauge gives a constant back pressure of $14·7 - 12·5 = 2·2$ lbs. Then, the coefficient for cutting off at one-third being ·7, the mean pressure exerted during the whole stroke is $(16+14·7) \times ·7 - 2·2 = 30·7 \times ·7 - 2·2 = 21·49 - 2·2 = 19·29$ lbs. per sq. inch.

The pressure given in my article was 19·25 lbs. per sq. in., which was considered sufficiently near the truth for the purpose.

As regards the assumption of 8 lbs. instead of 7·56 for the effective pressure of the caloric engine, the note at the foot of page 126 will show that the difference was fully understood; but the larger number was taken because that difference was slight, and indeed within the limits of imperfect observation, or conflicting reports of the real initial pressure. Finally, whether the consumption of fuel was 800 instead of 550 lbs. per hour, is quite unimportant; the smaller number was too great for economical application, as was shown in my former article.

At the time those remarks were made, we knew less about the caloric engine than at present, and it was supposed by many engineers that success was at least possible, although it might be the work of years to develope it. It was therefore the aim of the writer to show that the results at that time attained, were not such as to warrant any hope of its future success on the ocean, or indeed for locomotive power of any description. Further experience has destroyed all probability of its success in any capacity. M.

On the Composition of the Substances employed by the Chinese in the Decoration of Porcelain. By MM. Ebelmen and Salvetat.*

(Continued from page 242.)

The special results of these investigations show—

1. That the Chinese have only a small number of the colors known as *muffle colors* (colors which fuse a low temperature in comparison with that at which the procelain is baked).

2. That the palette of the Chinese is not composed of true colors, but rather of enamels; these enamels are glasses, that is, compounds of oxide of lead and alkalies, variously colored by a few parts per cent. of coloring oxides dissolved in them.

3. The composition of this glass is but little variable; it is always weakly colored; and it is even this weakness of tone and liveliness of tint which furnish the means by which the Chinese produce harmony and variety of color upon their porcelain.

4. These enamels are colored by oxide of cobalt, oxide of copper and gold; therefore by substances which are all readily soluble in the fluxes, the preparation of which is very simple.

In addition to these, antimony is employd for yellow, tin and arsenic acid for opake white. The Chinese mix these substances with the enamels, and these latter with one another, to produce very various shades of color. Their compound colors however are always referable to five coloring elements,—blue, oxide of cobalt; blue or green, oxide of copper; rose, gold; yellow, oxide of antimony.

If we add to these the very impure oxide of cobalt, which always gives a blue under the glazing; the same oxide, which is mixed with white lead to be burnt upon the glazing, and then furnishes a black; oxide of iron mixed with white lead or flux, to produce various shades of red; lastly, gold, which is rendered fit to be melted upon the glazing of the porcelain by being mixed with a tenth part of white lead,—we have all the means at the command of the Chinese decorator of porcelain.

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* From the London Chemical Gazette, No. 242.

The enamels are laid on with water, or sometimes with solution of gum or glue.

The authors attribute the circumstance, that glassy materials, such as these enamels, can be laid upon Chinese porcelain, without removing the glazing, to the peculiar composition of the latter. The composition of this was communicated in their previous memoir. A pure felspar glaze does not suit enamel. The authors attribute the peculiar appearance which distinguishes the Chinese and Japanese porcelain from European entirely to the composition of the glaze.

There is yet another kind of decoration employed for Chinese stone ware or porcelain, in which the objects are entirely colored, either with the pencil or by dipping. This mode of coloring will be considered by the authors in a third memoir.

The processes employed in Europe in the decoration of porcelain are shortly as follows:—Sometimes variously-colored pastes are employed, sometimes the coloring matter is introduced into the glaze, and sometimes the colors are laid on the surface of the white porcelain. The two first methods require the application of as high a temperature as that necessary for the baking of the porcelain itself. The colors so employed are therefore called *strong fire colors* (*couleurs de grand feu*). But when on the other hand, the colors are laid on the suface of the porcelain, they require for their vitrification a much less elevated temperature than the preceding. These colors are called *muffle colors* (*couleurs de moufle*).

They are the only colors which have hitherto presented, for painting on porcelain, resources comparable to those furnished by painting in oil; and it is with these colors, such as they have become by gradual improvement in the course of the last fifty years, that several works of the great masters have been reproduced on porcelain with the greatest exactitude.

The colors employed by the Chinese may also be divided into two similar classes of *strong fire* and *muffle colors*.

Some of the Chinese *strong fire colors* have not yet been reproduced on the European porcelain. They are extremely delicate, and often so beautiful that it is a matter of the greatest interest to be able to imitate them. The authors have nearly terminated their analyses of these colors, but in the present memoir they devote their attention exclusively to muffle colors.

The materials examined by the authors are derived partly from the collection formed in China by Father Ly, partly from the collection of the Ecole des Mines, and partly from that of the Musée Céramique. These colors are particularly employed at King-te-ching. The authors also made use of the colors employed at Canton and its neighborhood, which were partly collected by M. Itier, and partly by Mr. Rutherford Alcock, the English Consul at Shanghai.

M. Itier took his colors from the table of a Chinese painter who was engaged at the time in the decoration of porcelain. They offer a remarkable character of authenticity. Those sent by Mr. Rutherford Alcock to the Musée Céramique de Sèvres, appear to be a repetition of the collection exhibited last year at the Crystal Palace.

In Europe, and especially at Sèvres, the coloring metallic oxides are mixed with a flux, the nature of which varies according to that of the color. The most usual is the *gray flux* (*fondant aux gris*), which serves for gray, red, blue and yellow, and is formed by melting together—

Minium,	6 parts.
Quartz sand,	2 "
Glass of borax,	1 "

The colors are generally obtained by mixing together 3 parts of flux with 1 part of the metallic oxide, so that the composition may generally be expressed as follows:—

Silica,	16·7
Oxide of lead,	50·0
Borax,	8·3
Coloring metallic oxide,	25·0

Sometimes the oxide and flux are melted together, or calcined before being employed; sometimes they are simply mixed together. If the color be produced by a combination of the oxide with the flux, they must be melted together before use, in order that the color may possess the proper tone. If, on the other hand, the color be proper to the oxide, it need only be mixed with the flux, and must not be melted with it before use, as this double fusion frequently changes the colors. All the colors must melt at the same time, and present, after baking, a sufficiently uniform gloss.

These conditions are not fulfiled by the Chinese colors. Some of them are brilliant, well vitrified, and often laid on so thickly that they project from the surface. This is the case with the blues, greens, and yellows, and with the rose color obtained from gold. Others, such as the iron-reds and the blacks, are almost always less thickly laid on, less perfectly vitrified, and generally dull and muddy.

The Chinese paintings are always distinguished from ours by a very distinct character,—the figures and other objects are not properly printed but outlined with a black or red line; the tints are never lowered; the colors are laid on uniformly, and the painter then goes over this ground, either with the same or another color, so as to produce a motley work; but the mixture of the colors on the palette, which constitutes the greatest resource of our painters, appears not to be employed by the Chinese. The appearance of their paintings, when closely examined, reminds one of the mosaic church windows, which were fabricated with so much art in the thirteenth century, and in which the entire design, and all the forms of the figures and accessories, were produced by red or brown lines drawn upon fragments of white or colored glass.

From the thickness with which the Chinese lay on their colors, and their slight intensity, we may arrive at the conclusion, that these colors contain far smaller quantities of metallic oxides than those employed in Europe. The colors are rather *enamels*.

The names applied to samples investigated by the authors were attached to them in Chinese characters, and have been translated by M. Stanislas Julien.

The subtances examined included some primary substances employed in the fabrication of the colors. As to the colors, some, not having received any mechanical preparation, are in larger or smaller fragments, and are designated by the generic term *Seng;* the others are pulverized, and completely prepared for painting; these are included under the generic name *Si.*

1. *Crude Substances and Isolated Oxides.*

Sy-chy-mo (fine stone powder).—This is a siliceous, amorphous, grayish powder, becoming white on burning. Some minute spangles of mica are visible in it with the lens. It is infusible before the blowpipe, and presents all the properties of the siliceous sands employed in the fabrication of glass. Analysis gave—

Loss by heat,	0·40
Alumina,	0·15
Peroxide of iron,	0·45
Lime and magnesia,	traces
Silica,	98·70

The *Sy-chy-mo* is probably the substance employed by the Chinese in the fabrication of their colored enamels. They use it also, according to Father Ly, to harden colors which are found too fusible.

Yuen-feng (lead-meal).—Four different samples of this material were ascertained, on an analysis, to consist of white lead. This white lead is completely soluble in dilute nitric acid, with the exception of a trace of silica; it is free from oxide of copper and acetate of lead.

Fan-kong is a light red powder, which stains the fingers, is soluble in boiling muriatic and sulphuric acids, and not readily attacked by nitric acid. The Chinese use this substance mixed with some white lead, or silicate of oxide of lead, for the production of red. It appears that the Chinese prepare this red color by the calcination of some natural deposit of yellow ochre, although this cannot be determined with certainty, as Father d'Entrecolles has already informed us that the Chinese are acquainted with copperas (which they call *Tsao-fan*), and also with the residue of its distillation. The authors have examined two different samples, one, *a*, from the collection of the Ecole des Mines, the other, *b*, from that of the Musée Céramique. Their composition is—

	a.	*b.*
Moisture,	1·00	1·20
Silica,	3·90	3.12
Alumina,	trace	3.00
Oxide of iron	95.00	92.14
Lime,	trace	trace
Magnesia,	trace	trace
Loss,	0·10	0·54

Thsing-hoa-liao.—The Ecole des Mines possesses eight different specimens, three of first, two of second, and three of third quality. All the samples consist of the same material in various states of preparation. One of the three specimens of first quality presents the material in its rough state, as first taken from the mine; the others are in various states of purification. The collecton of the Musée Céramique only possesses one substance similar to the *thsing-hoa-liao*; it was sent by Father Ly under the name of *ching-lan*, which he translates *deep blue.* The collection sent by Mr. Rutherford Alcock contains several bulky specimens of this mineral, which is a peculiar kind of oxide of cobalt. It forms irregular fragments, containing hollow spaces, of a deep brown color with a greenish tinge, and furnishes a brown powder which stains the fingers. On being heated, it evolves water, and after long continued calcination acquires more of a greenish hue. At a red heat it suffers a loss of 20 per cent. in weight. It contains oxides of manganese and cobalt, but these two oxides do not form the whole of its mass. Muriatic acid leaves a residue of silicate of alumina. During solution in muriatic acid, chlorine is evolved, and the solution contains the metals. Analysis gave—

	Rough mineral.	Prepared mineral.
Loss (water and oxygen,)	20·00	4·00
Silica (insoluble residue,)	37·46	27·00
Oxide of copper,	0·44	2·00
Alumina,	4·75	65·00
Oxide of manganese,	27·50	
Oxide of cobalt,	5.50	
Oxide of iron,	1·65	
Lime,	0·60	1·00
Magnesia,	trace	trace
Arsenious acid,	trace	1·00
Oxide of nickel and sulphur,	trace	

The powder of this mineral melts with borax before the blowpipe into a rose colored globule, which however has a tinge of blue from the oxide of cobalt. Laid with the pencil upon a piece of burnt Sévres porcelain, then glazed and exposed to the strong fire, it furnished a blue tint in the thinner parts, becoming grayish in the stronger shades. The Chinese employ this substance for the production of blue pictures under the glazing; and if it be rich enough in oxide of cobalt, also in the preparation of the blue muffle colors; and lastly, in the production of black. All the samples come from the province *Yun-nan*, where the ore is dug from the summit of a mountain. Before use, it is roasted and pounded. The same statement has already been made by Father d'Entrecolles.

(To be Continued.

AMERICAN PATENTS.

List of American Patents which issued from April 12*th, to May* 10*th*, 1853, (*inclusive*,) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

APRIL 12.

14. For an *Improvement in Harrows;* William Berlin, Berryville, Virginia.

Claim.—"Having fully described the advantages of my improved harrow, what I claim is, the constructing a double frame work of iron bars or straps of metal, and the arranging and combining the two together by graduating bolts or adjustable screws and taps, by which means, or contrivance, the lower frame can be elevated or depressed, and the teeth or tines lengthened or shortened in their drag or dip."

15. For an *Improvement in Spring Mattresses;* Edwin L. Bushnell, Poughkeepsie, New York.

Claim.—"What I claim as my invention is, the mode or principle of securing the springs, by attaching the free extremity of each spring to the terminal coil of the adjacent spring, so that they mutually support each other, without the use of any inflexible frame of wood or other material, at the same time that in rolling or folding up the mattress, the outside ends of the springs expand or open, while the inside ends contract or close, and by which means any article, so constructed, will admit of being rolled or folded upon itself, or compressed, substantially as described."

16. For an *Improvement in Smut Machines;* H. L. Fulton, Chicago, Illinois.

"The nature of my invention consists, 1st, in the employment of a circular collar or prismatic shaped concentrator being placed between each pair of revolving scouring plates, and inclining toward the centre of the machine, for the purpose of throwing the grain, as it is, by centrifugal force and the fans, &c., thrown against the inner periphery of the outer casing or concave, back towards the centre of the machine upon the inclined fans and second scouring plate; and thus the grain is prevented from passing down between the inner periphery of the case, and the outer periphery of the revolving dished shaped plates, before it is perfectly cleaned. 2d, The employment of the revolving dished shaped scouring plates, in combination with the prismatic ring on the case, for the purpose of concentrating and directing the grain from one beater to the other."

Claim.—"Having thus fully described the nature of my invention, I would state that I am aware that a flat plate, on the side of the concave, has been used; this, therefore, I do not claim; but what I do claim as my invention is, the circular prismatic shaped brace and concentrator arranged between each pair of revolving scouring plates, and secured fast to the inner periphery of the case, for the purpose of concentrating the grain, and throwing it up the second scouring plate, and thereby preventing its escape, before it is effectually cleaned, from the first scouring plate, directly to the discharge passage, substantially as described. I also claim, in combination with the revolving dish shaped plates or beaters, such as herein described, the prismatic ring, for the purpose of concentrating and directing the grain from one beater to the other, substantially as described."

17. For an *Improvement in Match Splint Machines;* Reuben F. Gustine, Chicago, Ill.

Claim.—"What I claim as my invention is, the combination of the reciprocating knife, with a convex or protuberant rest, and feeding and holding mechanism, and the pressure roller, or any equivalent thereof, for the purpose substantially as described."

18. For an *Improved Coin Safe and Detector;* Jacob J. Hatcher, District of Spring Garden, Pennsylvania.

. *Claim.*—"Having fully described the nature of my invention, what I claim therein as new is, a coin safe, or receptacle for coin, consisting of the arrangement of the outer case and spring with its pad, for holding the coin up against the top of the case, and a slide with its projection, or their equivalents, for forcing out the coin through the slot provided for the purpose, substantially as described."

19. For an *Improvement in Manufacturing Rosin Oil;* Samuel W. Hawes, Boston, Massachusetts.

"My improvements consist in the arrangement of pipes in such a manner as to discharge the oil, during the process of distillation, separate from the spirits, acid, and naphtha, while at the same time the three last ingredients are discharged into a separate vessel, apart from the oil; this leaves the oil free from smell, and of much better color and quality than when manufactured in the ways now in use, when all the different ingredients are discharged through one and the same worm. Another important improvement is the discharging the still, after the oil has all been distilled, and recharging it, without cooling down and opening it, by which much time and expense is saved."

Claim.—"Having thus described my improvements in making rosin oil, I wish it to be understood, that I do not claim the form or kind of apparatus set forth, irrespective of its use, or particular application; my claims being founded upon the invention or discovery of improvements in the process of making rosin oil, by means of said apparatus, or any other the same or equivalent in principle. Therefore, I claim, first, in the process of making rosin oil, the charging and discharging the still, by means substantially the same in principle or mode of operation as those set forth, whereby I save the necessity of unluting, and prevent the incrustation of the still. Second, I claim in the process of making rosin oil, the separation of the oil from the mere volatile products, at different and distinct points remote from the still, instead of discharging them altogether, as heretofore done, substantially in the manner set forth, that is to say, by means of the series of recurved pipes, in combination with the series of condensers attached thereto, as set forth."

20. For an *Improvement in Shingle Machines;* Simon Ingersoll, City of New York.

Claim.—"Having described the nature and operation of my invention, what I claim as new is, the spring clipper, operated as described, in combination with the riving knife, for the purpose of insuring the complete separation of the shingle from the block, and at the same time throwing it on the lower bed, in position to be carried to the dressing knives by the next advance of the driver, in the manner substantially set forth."

21. For an *Improvement in Hot Air Registers;* Edward A. Tuttle, Williamsburgh, New York.

"The nature of my invention consists in constructing the leaves of a ventilator and register with projections on their surfaces, to form an ornamental fret work between the leaves or slats, when they are turned with their edges uppermost, or partially so, for the purpose of dispensing entirely with the open ornamental top plate, which is now employed on air registers and ventilators, to hide the rough brick work or back ground behind the ventilator and register."

Claim.—"What I claim as new is, constructing the leaves (of a register or ventilator) with projections on their surfaces, to form an ornamental open or fret work between the leaves, when they are turned with their edges uppermost, or partially so, for the purpose of dispensing with the separate front or top plate, of ornamental open work, now employed on registers and ventilators."

22. For an *Improvement in Feeding Clamps for Sewing Machines;* William H. Johnson, Granville, Massachusetts.

Claim.—"What I claim as my invention is, the use of a hollow rotary clamp, as described, for holding and feeding cloth, and other materials to be sewed, substantially as specified."

23. For an *Improvement in Mercury Baths for Daguerreotyping;* Benjamin F. Upton, Bath, Maine.

Claim.—"What I claim is, the improvement of combining with the mercury bath and the lamp for heating it, the sliding tube and the lever, (or their mechanical equivalents,) as described, so that by the expansion of the bath, the lever may be moved, so as to elevate the slide tube on the wick, and thereby decrease the flame of the lamp, and the heat thereof, or caused so to act as to maintain or nearly maintain equality of evaporation, in the manner and for the purpose as specified."

24. For an *Improvement in Washing Machines;* Charles F. Wilgus, West Troy, New York.

Claim.—"Having fully described the nature and operation of my invention, what I claim as new is, the employment of the revolving feeding net cylinder, in combination with the two sets or circles of rollers, one set of said rollers being allowed to yield, when the sack of clothes or other article is drawn round the net cylinder, and between the said sets of rollers, and made to spring back, by means of springs, which are connected to the rollers, in the manner substantially as shown; the whole being constructed, arranged, and operating in the manner described, and for the purpose of washing clothes, and fulling and flocking cloths, as set forth."

25. For an *Improvement in Manufacturing Gutta Percha and India Rubber;* Chas. Goodyear and Robert Haering, Assignors to Charles Goodyear, New Haven, Connecticut; patented in England, March 4, 1851.

Claim.—"Having fully described the nature of our invention, what we claim is, the art or method of manufacturing articles, composed in part of caoutchouc, or other gums susceptible of vulcanization, by heating or vulcanizing the same, when surrounded with and pressed upon externally or internally by or moulded in pulverized soap stone, sand, plaster, or other similar granular, pulverized or porous matter, or in moulds of plaster, or other porous substance, substantially as herein described."

26. For an *Improvement in Machinery for Shaving the Heads of Screw Blanks;* Cullen Whipple, Assignor to the New England Screw Company, Providence, Rhode Island; patented in England, November 30, 1852.

Claim.—"I am aware, that in machines for shaving the heads of screw blanks, the shaving cutter, whether moving on a slide or a rocker, has been moved towards and from the blank, obliquely to the axis of the blank, and therefore, I do not claim broadly the moving of such cutter obliquely; but what I do claim as my invention is, the method of shaving the heads of screw blanks, by causing the cutter to approach the blank obliquely, and in or nearly in line with the under side of the head, whereby the use of a rest, to support the blank against the pressure of the cutter, is dispensed with, substantially as herein set forth."

APRIL 19.

27. For *Improvements in the Feed Motion of Willowers;* Francis A. Calvert, Lowell, Massachusetts.

Claim.—"Having described my improved willower, what I claim as my invention is, the combination of a set of feeding rollers and endless feeding apron, having an intermittant motion imparted to them, for the purpose herein above set forth, with the cleaning cylinder of a willower."

28. For an *Improvement in Excluding Dust from Railroad Cars;* James M. Cook, Taunton, Massachusetts.

Claim.—"I lay no claim to the application of vertical blinds, shutters, or screens, on the outside of railroad cars, and made to stand at angles of about forty-five degrees therewith, and for the purpose of preventing the entrance of dust, smoke, or cinders, into the windows thereof; but what I do claim as my invention is, my improvement in the manner of constructing and applying a deflector to the outside of a railroad car; the same consisting, not only in making it to extend along the bottom horizontal or lower part, but up along the vertical side of a window opening, substantially as described, and so that while the car is in motion, the air impinged against by the vertical face of the guard will be driven or moved downwards, and made to pass under or over the guard so as to prevent the dust thrown directly upwards from the track, as well as that moving horizontally, or otherwise, from entering the windows, as described."

29. For an *Improvement in Machines for Planking Hat Bodies;* Phineas Emmons, City of New York.

Claim.—"Having described my invention, what I claim is, the combination of a reciprocating rotary rubber, or presser, with an endless elastic apron, so that by vibrating said rubber, a reciprocating intermittent differential movement is given to the apron, thereby operating on both sides of the body, and working it forward at the same time, substantially in mode of construction and manner of operation as herein set forth."

30. For an *Improvement in Machines for Rolling Bar Iron;* James S. Hartupee and Abram Alexander, Pittsburg, Pennsylvania.

Claim.—"What we claim as our invention is, the combination and arrangement of the two parallel horizontal rollers with the two vertical rollers, in such a manner that by raising or lowering the upper roller, (to form a thicker or a thinner bar,) one of the vertical rollers will be raised or lowered with it, and, at the same time, the peripheries of all the rollers be kept in contact, and in their proper relative positions with each other, and also in such a manner that by moving the lower horizontal roller endwise in its bearings, (to make a narrower or a broader bar,) the aforesaid vertical roller will be moved laterally with the said lower horizontal roller, while, at the same time, the peripheries of all the rollers will be kept in contact, and in proper relative positions with each other, substantially as herein set forth."

31. For an *Improvement in Cooking Ranges;* Alex. McPherson, City of New York.

"The nature of my invention consists in combining the construction of the grate with the mode of carrying the flues down the ends of the range, and under the oven."

Claim.—"Having described my invention and its operation, what I claim is, the arrangement of the vertical end flues and diagonal cross plate under the oven, for causing the gas to traverse under the entire surface of the oven of the hereinbefore described cooking range, and operating substantially as set forth."

32. For an *Improvement in Cutter Fingers of Harvesters;* John H. Maurry, Waddan's Grove, Illinois; patented in England, December 9, 1852.

Claim.—"What I claim as my invention is, constructing the lower part of the finger, or the upper or both, with a recess on either side, in front of the finger bar, and an angular ridge between the two recesses, to cut entangled fibres, whereby the clogging of the cutting apparatus is effectually prevented, as herein described. I also claim constructing the fingers so that the sides of its upper half will overhang those of its lower half; the cutter playing between the two, substantially as herein set forth."

33. For an *Improvement in Cotton Seed Planters;* Samuel Miller, Washington College, Tennessee.

Claim.—"Having fully described my invention, what I claim therein as new is, the combination of the open or latticed bottom of the seed hopper with the teeth on the axle passing through them into said hopper, for the purpose of drawing or forcing out the seed, so that they may be drilled into the ground, the whole being arranged in the manner and for the purpose herein described."

34. For an *Improvement in Machines for Threading Screw Blanks;* Thompson Newbury, Taunton, Massachusetts.

Claim.—"Having described the character and operation of the machine for threading and pointing screw blanks, what I claim therein as my invention is, 1st, The detached tool posts, combined and arranged substantially as described, in combination with the comb arm and arm for carrying the threading tool, under an arrangement and construction substantially as herein set forth."

35. For an *Improvement in Gig Mills for Dressing Cloth;* Amasa Woolson, Springfield, Vermont.

Claim.—"What I claim as my invention in a gig mill, or other machine for dressing cloth, is, hanging the cloth rollers in a revolving carriage, or its equivalent, by means of which the cloth is run in a reversed direction through the machine, without the necessity of winding it from, and rewinding it upon the cloth rollers, as herein before practised."

36. For an *Improvement in Sewing Machines;* Wm. Wickersham, Lowell, Mass.

Claim.—"Having described my machine, what I claim is as follows: I lay no claim to the combination of a single hooked needle and two thread guides, or carriers, as made to operate together in a knitting machine, and for the purpose of laying two threads over a needle, during the process of the formation of a knit fabric; but what I do claim as my invention or improvement is, the combination of a single needle and two thread guides (carrying separate threads,) so operated that during one passage of the needle through and out of the cloth or other material to be sewed, one of the said guides shall lay its thread in the hook of the needle, while during the next passage of the needle through and out of the cloth, the other guide shall lay its thread in the hook of the needle, each guide acting alternately, as herein before specified. And for the purpose of enabling a machine of the above description (or one in which two thread guides and a single needle are employed to sew with two threads,) to be used for producing the chain stitch with one single thread passing through one of the eyes (*s t*,) of its two thread guards, H, I, as described, I claim the improvement of making one of the said guides, viz: the guide, I, with its long slot, *u*, for receiving the thread in its passage to and through the other guide, as specified. I also claim the above described peculiar mode of sewing cloth, or other fabric, viz: by combining two threads with the fabric, by drawing them through from the same side of the cloth, and through each other's loops, interlocking them in plegma stitches, so that the threads alternately bind each other, substantially as specified. I do not claim a hooked needle, having a contrivance, such as either a lever turning on a fulcrum applied to, or a needle or wire made to extend and work through the shank of the hook, as is used in knitting machinery; but what I do claim in a sewing machine is, the improved arrangement of applying the closing slide of the hooked needle to the same side as the barb, or hook, so that it may slide in a groove in the needle, or carrier, parallel to the motion of the needle, in the manner and for the purpose as specified."

37. For an *Improvement in Purifying Rosin Oil;* Samuel L. Dana, Lowell, Assignor to the Proprietors of Locks and Canals of the Commonwealth of Massachusetts.

Claim.—"I do not confine my claim to the use of lime as a base in the above process, although I prefer it; alumina, magnesia, potash, or soda, or oxide of lead, may be used in the proportion which their atomic weights bear to that of lime. What I claim as my invention is, the above described process, or its equivalent, of preparing a rosin oil free from the peculiar and offensive odor which characterizes the rosin oil of commerce, by combining, as above described, the fluid formed by the first distillation of rosin, or rosin oil, however produced, with slaked lime, or other alkaline, earthy, or metallic base equivalent thereto, as above described, and distilling from the compound thus formed a deodorized preparation of rosin oil, substantially in the manner above described."

APRIL 26.

38. For an *Improvement in Sugar Drainers;* Henry Bessemer, Baxter House, England; patented in England, Feb. 24, 1852.

Claim.—"Having described the nature of my said invention, and the manner in which the same is to be performed, I would have it understood that what I claim as my invention is, the combination of the revolving and hollow spreading table, formed with a wire gauze or perforated top, (and connected with an air exhausting apparatus,) the spreading mechanism, the water sprinkling pipe, or its equivalent, the means of discharging the water and molasses, and that of removing the cured sugar; the whole being substantially as specified."

39. For an *Improvement in Smut Machines;* Samuel Cook, Brockport, New York.

Claim.—"Having fully described the nature of my invention, what I claim therein as new is, the construction, combination, and operation of the fan, screening plate, and brush in the cylinder, and the openings and tubes or pipes leading therefrom; when the fan is placed below, and the brush above said plate, so that the blast created by the fan shall be drawn through the plate, and also, when said cylinder is provided with discharge openings and tubes, for conveying off the full wheat, the lighter grains and the dust in separate directions, substantially as described; and this claim, whether the same be effected in a single cylinder, or in two or more, so long as they are the same, substantially, in construction and operation."

40. For an *Improvement in Machines for Folding Envelopes;* Ezra Coleman, Philadelphia, Pennsylvania.

Claim.—"Having fully described the construction and operation of my machine for pasting and folding paper, what I claim therein as new and of my invention is, 1st, The lifter, D, which acts in the double capacity of taking the paper from the package to the folders, and hold it while the ends are being folded. 2d, The folder, K, in combination with the pedals, in such a manner as to hold the paper by the end folders pressing it upon the bed while the sides are being folded; the connexion between the pedals being through the medium of racks, pinions, and pulleys, or other analogous devices. 3d, The arrangement of the roller, L. in combination with the handle, B, by means of arms, rock-shafts, and levers, or other analogous device, so arranged that the simple action of raising and lowering the handle, B, distributes the paste on F; and, 4th, The roller, Q, for the purpose of removing the paper after it has been folded, substantially as herein described, and for the purpose set forth."

41. For an *Improvement in Straw Cutters;* Reuben Daniels, Woodstock, Vermont.

Claim.—"What I claim as my invention is, the combination of a series of straight rotating blades, whose cutting edges are equi-distant from and parallel to a common axis of rotation, and hence describe a cylinder when they rotate, with a fixed blade having a curved edge given to it, as described, and corresponding to a line drawn obliquely on the cylinder, generated by the rotating blades, and set in a position coinciding with that line, when by a series of straight knives on a cylinder, are made to cut obliquely, or with a shearing cut, by the oblique adjustment of the fixed blade only."

42. For an *Improvement in the Construction of Iron Candlesticks;* Wm. P. Merriam, Norman C. Harris, Wm. Wheeler, and E. N. Merriam, Poultney, Vermont.

Claim.—"Having fully described the nature of our invention, what we claim therein as new, is, the mode of constructing candlesticks of sheet metal, substantially as herein described."

43. For an *Improvement in Hot Air Furnaces;* James Bolton, M. D., Assignor to Chas. D. Yale, Richmond, Virginia.

"The nature of my invention consists in packing the space called the air chamber, between the stove, furnace, or other heating contrivance, and the wall which encloses said chamber, with metallic scraps, twisted into a spiral form, or bent into other shapes, so as to allow a space between these scraps for the passage of air; these scraps possessing the property of conducting heat, and of absorbing that which is radiated, and of imparting the heat to the air within the chamber."

Claim.—"What I claim as my own invention is, packing the air chamber, connected with any contrivance for heating the air which it contains, with spiral metallic scraps, or scraps of metal bent into other shapes, by which the same effect is produced; these scraps being designed for the conduction of heat and absorption of radiant heat, whether they be loose or connected with the adjacent walls, or heating contrivance."

44. For an *Improved Towing Apparatus for Canal Boats;* Stephen F. Palmer, City of New York.

Claim.—"I do not claim, of itself, the use of a wheel, or drum, containing the spring upon or in which to wind a line, as I am aware that such drum, with spring, is in use, as applied to tape and clothes lines; but what I do claim as my invention is, the arrangement of the wheel, with the spring wound upon its axle, and fastened to the frame, as described, in connexion with the brake and the tow line, in the manner and for the purposes herein fully set forth."

45. For a *Machine for Pointing and Threading Screw Blanks;* Thomas J. Sloan, City of New York.

"My invention consists in combining, in an organized machine, a cutter and its appendages, for forming the point on screw blanks, with the chaser or cutter, which cuts the thread over the shank and pointed part thereof, down to the point."

Claim.—"I wish it to be understood that I do not limit myself to the precise manner of mounting and giving the required motions to the cutter, for forming the point on the blank, or the chaser for forming the thread on the shank and point, as these may be varied by the substitution of mechanical equivalents. I am aware that letters patent were granted to L. D. and Jacob Walter, on the 7th of February, 1842, for an instrument or tool to be applied to a mandrel or lathe, for the making of screw bolts, in which there is a cutter for cutting or reducing the diameter of the rod to form the shank and leave the head, and then to cut off the bolt from the rod, leaving a conical point, and having this combined with dies for forming a thread on the shank; but such instrument is not applicable to, nor could it be employed in the manufacture of wood screws from wire, with the head swedged up, as it is termed; nor is the said instrument adapted to the forming of a complete thread on the conical point; and therefore I do not wish to be understood as making claim, broadly, to the combination of a cutter for pointing with the dies, for forming the thread on the cylindrical part of the shank. But what I do claim as my invention is, combining in an organized machine, a cutter and its appendages, operated substantially as specified, for forming the point on screw blanks, as specified, with the chaser or cutter, which cuts the thread over the shank and pointed part thereof, down to the point, substantially as specified."

46. For an *Improvement in Potato Diggers;* Thomas B. Stout, Key Port, New York.

Claim.—"In the above improvement I claim nothing separately; the cylinder with its teeth attached has been previously employed for other, if not similar purposes; but what I claim as new is, the cylinder, with the teeth attached to its periphery, in combination with the beater, and forked cutter, the cylinder, beaters and cutter being constructed and arranged in the manner substantially as herein shown and described."

47. For an *Improvement in Radiators for Stoves;* Samuel D. Tillman, Seneca Falls, New York.

Claim.—"Having fully set forth the character and advantages of my improvements in radiators and air heaters, or coolers, what I claim therein as new and original is, having the entrance and exit passages on the same horizontal line of the radiator, or nearly so, and at or about the position or the line of the middle horizontal section of the radiator, when such arrangement of these passages is combined with a series of flattened tubes, or air passages, and horizontally winding smoke passages, substantially in the manner and for the purposes herein set forth. And I also claim, in combination with the vertical air spaces and smoke passages formed by the flattened tubes, the successive contraction of the air spaces, in the manner set forth; that is to say, the air spaces varying in thickness, or the width of their cross section, as they recede from the source of heat, each tube being of uniform width or thickness throughout, but narrower, or thinner, than that which precedes it."

48. For an *Improvement in Processes for Preparing Gold;* Alfred J. Watts, Utica, N. Y.

Claim.—"What I claim as my invention is, the within described processes of preparing or crystallizing gold, for the purpose of filling teeth, substantially as herein set forth and described."

49. For an *Improvement in Rice Hullers;* David Marsh and Bennet Whitney, Fairfield, Connecticut.

Claim.—"Of the above described machinery, we claim the two dentated cylinders, and the dentated beating arms running between them, to be used in connexion with the above described machinery."

50. For an *Improvement in Cementing Materials for Ornamental Compounds;* Chas. Ludwig Gran, Hamburg, Germany, Assignor to Conrad Poppenhusen, Brooklyn, New York; patented in Germany, December 18, 1847.

Claim.—"What I claim as my invention is, the method of making artificial veneers. etc., by combining with saw dust, or the equivalents thereof, as herein specified, the curd of milk, and lime, or its equivalent, after these latter have been triturated and thoroughly mixed and reduced to a semi-fluid state, substantially as specified."

51. For an *Improved Chain Cable Stopper;* John E. Crane, Lowell, Massachusetts.

"My improved self-acting chain stopper consists of a metallic ridge secured to the deck of a vessel, near the hause hole, and a pawl secured to the bulwark, or knight head, (or other suitable support,) in such a position that its acting end will fall upon the top of said ridge, substantially as represented in the drawings."

Claim.—"I am aware that a pawl or nipper has been hinged above the hause hole, for the purpose of stopping the cable, by pressing it against the under side of the hause hole; and I am also aware that a chain stopper has been described, which consists of two concave plates of iron, between which the chain passes; the lower one of the said plates being firmly secured to the deck, and the upper plate being turned upon a hinge, and the chain stopped by pressing it tightly between the said plates, by means of leverage applied to the upper plate; and, therefore, I wish it to be understood that I disclaim having invented the equivalent, in principle or action, of either of the said chain stoppers; but what I do claim is, the ridge rising from the deck of a vessel, between the hause hole and the windlass, combined with a heavy pawl placed above it, the said parts being arranged as herein described and represented, whereby each moving link of the cable is turned flatwise in passing over the ridge, and each link is acted upon by the pawl, substantially as described."

Re-issues for April, 1853.

1. For an *Improvement in Machinery for Trimming Books, &c.;* Larnard F. Markham, Cambridgeport, Mass.; dated April 18, 1848; re-issued April 19, 1853.

Claim.—"What I claim as my invention is, the turning and adjustable book holder, arranged as herein above described, so as to be made to assume either of the three positions herein above specified, and so that the three edges of a book may be trimmed by a single adjustment of the same in said holder, and by the movement of said holder on its pivot consecutively to each of the aforesaid three positions; whether such holder be combined with a reciprocating knife or cutter having any other shape or motion. I also claim the adjustable frame, in combination with the turning book holder, or the turning and adjustable book holder, for the purpose herein above specified. I also claim the combination of the table (on which the book holder is supported) arranged so as to be gradually raised to convey the edges of the book to the knife, with a reciprocating knife, or any other knife or cutter having any other shape or motion."

2. For *Improvements in Movable Breeches for Fire Arms and Appurtenances to the same;* Benjamin Chambers, Washington, D. C.; dated July 31, 1849; re-issued April 19, 1853.

"The nature of my invention consists in combining with a hinged breech piece, the support, slot, and lever, whereby the said breech piece is easily moved into and out of place, in closing and opening the gun for the purpose of loading, swabbing, &c. Also, in combining with a gun having a dissected breech, the flanched shield, through which the cartridge is made to pass into the chamber over the dissected screw, without danger of being broken by the ends and edges of the threads. Also, the enlargement near the shoulder of the rammer, whereby the shield through which the cartridge has been rammed is made to adhere by friction to the rammer, and to be drawn out of the breech of the gun, without requiring a second operation for taking it out. And lastly, the perforated point or nipple on the percussion cap."

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, in combination with a hinged breech piece, the support, the slot, and lever, whereby the said breech piece is easily moved into and out of place, in closing and opening the gun for the purpose of loading, swabbing, &c., substantially as described. I also claim, in combination with a gun having a dissected screw breech, the flanched shield, through which the cartridge is made to pass into the chamber over the dissected screw, without danger of being broken by the ends and edges of the threads, as herein set forth. I also claim, in combination with a rammer for charging guns at the breech, the projecting central point, whereby the cartridge is being driven to its place in the chamber, is perforated at its base, to receive the point of the percussion cap herein described, for the purpose of insuring the ignition of the gunpowder, as set forth. I also claim the enlargement near the shoulder of the rammer, whereby the shield through which the cartridge has been rammed is made to adhere by friction to the rammer, and to be drawn out of the breech of the gun, without requiring a second operation for taking it out. And I wish it to be understood, that in these claims I shall not confine myself to the exact arrangement of parts herein described, but shall vary the same at pleasure, while I attain the same ends by means substantially the same."

3. For an *Improved Cannon Lock;* Benjamin Chambers, Assignor to Joanna Chambers, Washington, D. C.; patented July 31, 1849; re-issued April 19, 1853.

"The nature of my invention consists in forming upon the lock, or the pin or piece to which the lock is attached, the sectional or quarter screws, male and female, for the purpose of speedily removing the lock to supply it with the cap, pellet, or other material by which the gunpowder is ignited, and of firmly holding the same in place on the gun when it is to be discharged."

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the method of securing the lock to the gun by means of the sectional or quarter screws, for the purpose of speedily opening or removing the lock to supply it with the cap, pellet, or other material by which the gunpowder is ignited, and for firmly holding the same in place on the gun when it is to be discharged, substantially as herein described. I also claim forming the gun lock in such a manner, that the hammer rod and the percussion rod shall be in separate pieces, laying axially within the same barrel whereby the coiled main spring is made to urge the hammer rod against the head of the percussion rod to discharge the piece, and the recoil spring on the percussion rod is made immediately to draw back, and hold the valve which closes the interior of the lock against access of smoke and gases, as herein set forth."

4. For an *Improvement in Reaping Machines;* Wm. F. Ketchum, Buffalo, New York; patented July 10, 1847; re-issued October 21, 1851; re-issued April 26, 1853.

Claim.—"Having fully described my improvements, what I claim as my invention is, 1st, Placing the cutter bar and cutters lower than the frame of the machine and opposite the side of the plane of the wheel, in such a manner as to leave unobstructed space below the frame, and also between the wheel and the cutters, with their supports, to allow the machine to pass freely and without clogging over the cut grass or grain, as set forth. 2d, I also claim placing the cutters lower than the frame and axle, and in or nearly in the same vertical plane with the axle on which the frame hangs and vibrates, and parallel or nearly so to said axle, so that the vibrations of the frame, on uneven ground, shall not materially elevate or depress the cutters, as herein set forth. 3d, I also claim the endless chain of cutters, in combination with the guard teeth, operating substantially as described."

DESIGNS FOR APRIL, 1853.

1. For a *Bust of Daniel Webster;* Thomas Ball, Boston, Mass., April 19.

Claim.—"What I claim as my production is, the new design of a bust of Daniel Webster, of colossal size, as represented in the drawing."

2. For a *Water Cooler;* Edward M. Mangle and George Phipps, County of Philadelphia, Pennsylvania, April 19.

Claim.—"We do not claim any of the separate ornaments; but what we do claim as our invention is, the design and configuration of the ornamental water cooler herein above described."

3. For a *Clock Case Front;* Charles Chinnock, City of New York, April 19.

Claim.—"What I claim as my invention or production is, the design and configuration of the plate shown in the drawings and described, forming the front of a clock case."

4. For a *Clock Case Front;* Charles Chinnock, City of New York, April 19.

Claim.—"What I claim as my invention is, the design and configuration of the metal plate represented fully in the drawings, the same forming the front of a clock case."

5. For a *Clock Case Front;* Charles Chinnock, City of New York, April 19.

Claim.—"What I claim as my invention or production is, the design and configuration of the plate, as described and represented in the accompanying drawings, forming the front of a clock case."

6. For a *Cooking Stove;* Jacob Beesely, Assignor to William P. Cresson, District of Spring Garden, Pennsylvania, April 19.

Claim.—"What I claim as my invention is, the combination and arrangement of the ornamental forms and figures represented in the drawings, and forming together an ornamental design for a cooking stove."

7. For a *Cooking Stove;* Samuel H. Sailor, Philadelphia, Pennsylvania, April 19.

Claim.—"What I claim as my invention or production is, the configuration and arrangement of the ornaments in bas-relief, as described in this specification and drawings, on the front plates, feed door, curved surface, doors, panels, and legs, forming a new and original design of cook stove, denominated the Victor Complet."

8. For *Girandoles, Candelabra, &c.;* Robert Edwin Dietz, City of New York, April 26.

Claim.—"What I claim as my production is, the combination and arrangement of the ornaments described and set forth, to form an ornamental design for girandoles, candelabra, &c."

9. For *Ladies' Hair Combs;* Jeremiah Hills, Newtown, Connecticut, April 26.

Claim.—"What I claim as new is, the design and configuration of the series of loops, forming the chains, as herein described and represented in the drawings."

10. For a *Portable Range;* Garrettson Smith and Henry Brown, Assignors to North, Chase, & North, Philadelphia, Pennsylvania, April 26.

Claim.—"What we claim as our invention is, the design and configuration of the mouldings and ornamental work, as herein described, forming an ornamental design for a portable range."

11. For a *Cooking Stove;* Samuel H. Sailor, Assignor to C. W. Warnick and F. Leibrandt, Philadelphia, Pennsylvania, April 26.

Claim.—"What I claim as my invention or production is, the configuration and arrangement of the ornaments in bas-relief, upon the doors, side plates, bed plate, back, and feet, as described in this specification and the drawings, forming a new and original design for cook stoves, designated as the Capitol."

12. For a *Portable Range;* John C. Smith, Assignor to C. W. Warnick and F. Leibrandt, Philadelphia, Pennsylvania, April 26.

Claim.—"What I claim as my invention or production is, the configuration and arrangement of the ornaments and mouldings upon the plate, door, and foot, as set forth in this specification and the drawings, forming a new and original design for the front of a portable range."

MAY 3.

1. For an *Improvement in Revolving Fire Arms;* Robert Adams, London, England; patented in England, February 24, 1851.

"The improvements in the construction of rifle barrels of fire arms, consist in forming raised ridges on the inner surface of such barrels, in place of grooves, or the ploughed hollows, commonly called rifling; and I prefer to form such ridges angular, as shown by the section of a barrel; but the shape and number of such ridges may be varied."

Claim.—"I claim the improvement of combining with the frame and the hammer the spring for holding the hammer back; the sear attached to the trigger, by a swivel joint, and acting on the hammer; the stop or projection on the trigger, for holding the chambers in position, when firing, substantially as herein described."

2. For an *Improvement in Elastic Exercising Machines;* Richard L. Hinsdale, City of New York.

Claim.—"I am not aware that the elastic bows have ever been applied, solely, to the purposes of exercise, and aside from the discharge of arrows. What I claim is, 1st, The bows on their hubs, and the strings and handles, either alone or in combination with the spring and vibrating platform. 2d, The elastic reciprocators, made and operating as described. 3d, The bows on the brackets, or their equivalents, either alone or in combination with the spring platform, for the purposes of vertical exercise, as described and shown."

3. For an *Improvement in Mould Candle Apparatus;* George Kendall, Providence, Rhode Island; patented in England, Nov. 12, 1852.

Claim.—"Having described my improvements, and indicated a few of the many modifications of which they are susceptible, what I claim therein as new is, 1st, The arrangement of the traveling and fixed railways, on which the moulds are transferred from place to place, as required in the process of casting candles, as herein described, in combination with an oven for heating the moulds, a melting pot, to prepare the fat for casting, and apparatus for drawing the candles from the moulds, substantially as herein set forth. 2d, In combination with a series of moving stands of moulds, I claim the counterpoised hooks, or the equivalent thereof, arranged and operating as herein set forth, to aid in drawing the candles and centreing the wick, in such manner as to dispense with much of the care and skill heretofore required for the performance of this operation. 3d, I claim an elastic or a yielding cap, for the lower end or tip of the moulds, which performs the two functions of stopper, and the friction brake, to stretch the wick, substantially as herein set forth. 4th, I claim the wick clamp, constructed and operated as herein set forth.

4. For an *Improvement in Manure Carts;* Daniel Reid, Washington, North Carolina.

"The nature of my invention consists in spreading the guano, or other manure, equally on the surface passed over by the cart, or in depositing the same in hills, at regular intervals."

Claim.—"I claim as my invention, the measuring valve apparatus, beneath the lower hopper, in combination with the said hopper, for discharging manure in hills, as set forth."

5. For an *Improvement in Corn Shellers;* George W. Reid, Evansville, Indiana.

Claim.—"Having fully described my improved corn sheller what I claim therein as new is, the combination and arrangement of the sloping longitudinal slat screen, and the transverse slat screen, for the rapid and thorough separation of the corn from the cobs, as they are thrown from the concave, by the shelling cylinder, upon the said combined screens, substantially as herein set forth."

6. For an *Improvement in Machines for Sawing Barrel Heads;* Paris J. Steere, Cheshire, Massachusetts.

Claim.—"Having described my invention, what I claim as new is, the finger in combination with the movable shaft, for the purpose of converting the curvilinear motion of the saw into a rectilinear motion, in the manner substantially as described."

7. For an *Improvement in Machines for Shrinking Hat Bodies;* James S. Taylor. Danbury, Connecticut.

Claim.—"What I claim is, the process of shrinking or sizing the hat bodies, by passing them longitudinally into or through a chamber, formed by placing several cylinders or rollers (having concave or other denomination of surfaces) in such a proximity as to form the said chamber, as herein before substantially set forth."

8. For *Improvements in Repeating Fire Arms;* Charles N. Tyler, Worcester, Mass.

Claim.—"What I claim as my invention is, 1st, Arranging the cock in such a manner that it may be raised and will stand up, without being held by a sear or catch, and may then be gradually lowered again without tripping to fire the charge, or may be tripped to fire the charge, at the option of the operator, whether the devices employed be such as are herein particularly described, or the equivalent thereof, for producing the same result. 2d, The movable stop operated upon by a stud or button, protruding through to the outside of the stock, in combination with a fixed rest, and the jack, substantially as described, for the purpose of preventing the jack being thrown far enough back to clear the tongue, through which the trigger acts upon it, whereby the escape of the driver or hammer is rendered impossible while the stop is in operation. 3d, The magazine, constructed with a self-acting driver, which places the cartridges in succession in front of the discharger, and with a discharger that will draw itself back, and place the pulling rod in the proper position for transferring the cartridge into the breech, so that they may be transferred as required, by simply pressing with the finger upon the pulling rod. I am aware that a magazine or charger is described in the patent for a shoe pegging machine, granted to John Robinson, October 31st, 1848, and I make no claim to any thing in it."

9. For an *Improvement in Apparatus for Drawing Water from Wells,* Samuel R. Wilmot, New Haven, Conn., Assignor to Joseph Kent, Baltimore County, Md.

Claim.—"What I claim as my invention is, the projecting stud, in combination with the spring and grooved pulleys, for the purpose of contracting the spring by the weight of the bucket, and causing the pulleys to grasp firmly the way, in the manner and for the purposes herein specified."

10. For *Improvements in Rails for Rail Roads:* Patrick O'Reilly, Reading, Pa.; antedated November 3, 1852.

Claim.—"What I claim as my invention is, the divided or double plate rail herein described, which is composed of a flanched arch or bridge rail, of the usual form, and about half the usual thickness and weight, with another rail of similar external form, thickness, and weight, on which it rides; the underside of the arch of the upper rail or rider forming a groove to fit over and rest upon the arch or tongue of the lower rail, the flanches of the upper rail resting upon and fitting those of the under rail, and the spike holes of the two corresponding, so that the same bolts or spikes will secure them firmly together and to the foundation; the compound rail thus formed and proportioned, having a double bridge and a double base, the two portions of which reciprocally support and strengthen each other. I likewise claim the method herein described, of strengthening the joints of the ordinary bridge rail, while leaving its middle of adequate strength, by moving a longitudinal section of its inside, equal to about half the weight of the rails, half its length endwise, so as to break joint with the outside, or constructing the rail in two parts to correspond, in form and position, with the two parts of the inner half where divided from the outer, and moved as aforesaid, whereby the joints of the upper rail are rendered as capable of supporting the load at its middle, and the whole made stronger, with a given quantity of material, than by any mode of construction heretofore known."

11. For an *Improvement in Rails for Railroads;* J. Dutton Steele, Pottstown, Pennsylvania, Assignor to Charles E. Smith, Philadelphia, Pennsylvania.

Claim.—"Having fully described my invention, what I claim therein is, the construction of a rail in two parts, and which is composed of a flanched or bridge rail of usual form, with another rail, or splice plate, of similar external form, on which it rides; the underside of the arch of the upper rail forming a groove, to fit over the arch or tongue of the lower rail or splice plate, and the flanches of the one overlaying and resting upon the flanches of the other; and the flanches may be riveted together, or the spikes or bolts fastening the rails, at large, to their bearings, may be made to pass through the said flanches, and thus perform the double office of fastening them together, and to their bearings, and the interior rail may have a solid or hollow tongue, or rib, and it may have a length sufficient to give it a bearing on three sills or crossties, directly under and adjacent to the joint, or it may be equal, in length, to the upper or main rail, and brake joints with it, as may hereafter be found the most desirable."

MAY 10.

12. For *Improvements in Counter Sinks;* Asahel G. Bachelder, Lowell, Mass.

Claim.—"What I claim as my invention is, an independent counter sink, so constructed that it may be used on different sized bits, or other instruments for boring, for the purpose of counter sinking, as well as gauging the depth of the hole, at the same time it is bored, substantially as described."

13. For an *Improvement in Pump Valves;* Nehemiah Dodge, City of New York.

Claim.—"What I claim is, an arched valve, formed by passing two planes, inclined to each other, through a semi-cylinder of the same diameter with the bore of the pump, the sectional valve thus formed, being hinged by one vertex to the interior of the bore, for the purpose herein before substantially set forth."

14. For an *Improvement in Washing Machines;* E. L. Evans, Hartford, Conn.

Claim.—"What I claim as my invention is, the combination of the rubber A A′ and rod or handle F, for the opening or closing said rubbers, by the same handle with which the rubbing is performed; I also claim the combination of the rubbers E′ R with the rubbers A′ A and the bars *d*, so that the two pairs of rubbers shall, each of them, grasp the cloth and rub it between them, substantially as herein set forth and described."

15. For an *Improvement in Invalid Locomotive Chairs;* Thomas S. Minniss, Meadville, Pennsylvania.

Claim.—"What I claim as my invention is, the combination of the wheel, axle and shank, on the end of the projecting arm, by which a central support is given to the frame within the dish of the wheel; the bearing in the hub being central with the bearing of the rim, permitting a free lateral movement to the wheel, without changing its point of support to the frame, and enabling the wheel to receive any shock on its rim with firmness, while its plain surface is left unobstructed from the free movements of crank and handle. I also claim the arrangement of the adjustable handle, which can be used to pull the chair, or as a guide in the hands of the invalid, when pushed by another, or changed to a crank of various length of stroke, to suit the invalid, when he wishes to propel himself with his own hand. The materials used in the construction of said machine, being wood, iron, or other material, as convenience or fancy may dictate."

16. For an *Improved Ditching Machine;* Jonathan W. Morrill, Hampton Falls, New Hampshire.

Claim.—"What I claim as my invention is, 1st, The employment of the swinging cutter, in combination with the swinging spade, the whole being constructed, arranged and operated in the manner and for the purpose substantially as herein set forth. 2d, I also claim the combination of the swinging cutter, swinging spade, and lever, the whole being arranged and operated in the manner and for the purposes herein specified."

17. For an *Improvement in Fastening Leather Beltings;* Enoch Osgood, Bangor, Me.

"The nature of my invention is such, that by the employment of metallic hooks and eyes, on tapering screws, inserted into the edges of leather belting, the same may be closely united, and made to run smoothly."

Claim.—"What I claim as my invention is, the application of the tapering screws, with hooks and eyes, screwed into the edges or ends of leather or belting, for the purpose of uniting the edges together as above described."

18. For an *Improvement in Registering Apparatus for Printing Presses;* John W. Richards, Hoboken, New Jersey.

Claim—"I do not claim the rock shaft, or point arm *d*, and point 3, as these are well known; but, what I claim is, 1st, the circular slotted plate, let in flush with the face of the feed board, and fitted so that it can be rotated, to bring its radial slot into any desired position, to pass the registering point, as described and shown. 2d, I claim the spindle 9 and arm 11, connected to and combined with the circular slotted plate, so as to slide vertically, when actuated by competent mechanical means, and project the point 12, through the slot in the plate, as specified."

19. For an *Improvement in Machines for making Wrought Nails;* John P. Sherwood, Fort Edward, New York.

Claim—"What I claim as my invention is, the combination of a revolving cam drum with the converging die stocks, moving in directions oblique to the axis on which the cam drum revolves; the cams being constructed as herein set forth, with two curved faces meeting at an angle; the whole arrangement being such, that dies moving at right angles to each other, are operated by a single drum, without the intervention of rods or levers. I also claim the compound gauge and nipper (x) which acts as a gauge, to regulate the breadth of the nail blank, and also, as a nipper, to hold it firmly during the action of the pointing die, the same operating as herein described."

20. For an *Improvement in Operating and Controlling the Rudder of Steam Vessels;* Frederick E. Sickels, City of New York.

"The nature of my invention consists in combining with the steersman's handle and the rudder, an engine, so arranged as to move and hold the rudder, with and against the force of the propelling engine."

Claim—"Having fully described the nature of my invention, what I claim therein as new is, operating and controlling the rudder of a vessel, by combining the steersman's handle and the rudder, with an engine, so arranged, as to move or hold it, with and against the force of the propelling engine, substantially as described."

21. For *Improvements in Machines for making Hook Headed Spikes;* John H. Snyder, Troy New York.

Claim.—"What I claim as my invention is, rolling wedge pointed spikes between rotating dies, so formed that the face of one shall be the reverse of one face of the spike, when formed, and the face of the other die to correspond, in the rotation, with the other face of the spike, substantially as specified. I also claim forming hook heads on spikes, by rolling from the point towards the head, to force the surplus metal towards the head, and then bending and giving the form required, by a lip on one of the dies projecting beyond its face, so that it shall have an increased motion, by reason of its greater radius, to give the required form, substantially as described. I also claim, in combination with the dies for rolling the shank of the spike, making the heading lip, for forming the head, movable, by forming the said lip on the end of a bar adapted to slide in the stock of the die, substantially as and for the purpose specified. I also claim, in combination with the rotating dies, the employment of the sliding cutter and carrier, substantially as specified, for cutting from a rod the required lengths of rod, and carrying thereto the rotating dies, substantially as specified. And finally, I claim, in combination with the rotating dies, the slides for presenting and forcing the end of the rod into the rotating dies, to insure the proper position of the rod in the dies, substantially as specified; for, if the rod be not griped by the dies at the proper time, there will be either too much or too little metal for the forming of the head."

22. For an *Improvement in Manufacturing Malleable Iron directly from the Ore;* George A. Whipple, Newark, New Jersey.

Claim.—"Having fully described my improvements in iron manufacture, what I claim therein as new is, forcing down upon the iron ore, from the roof of the furnace, in the different stages of the process, as required, and on the different hearths, atmospheric air, either heated or cold, for the purpose of decarbonizing the ore, and bringing the iron to nature, or refining the same and regulating the degree of heat, substantially in the manner and for the purpose herein described."

23. For an *Improvement in Locomotive Engines;* D. Winder, Xenia, Ohio.

Claim.—"What I claim as my invention in locomotive steam engines is, the employment of three engines, connected with a three throw crank on the driving shaft, with the cranks arranged at equal distances apart on the circle, substantially as specified,when this is combined with the employment of valves, stop cocks, or their equivalents, for letting the steam on both ends, or cutting it off from one end, to work the engines, on the single or double acting principle, substantially in the manner and for the purpose specified."

24. For an *Improvement in Paint Compounds;* Charles F. Sibbald, Philadelphia, Pennsylvania; patented in England, October 15, 1852.

Claim.—"Having described the manner in which my metalline compound may be made, and pointed out a few of its uses, I do not claim either of its elements separately; but what I do claim as my invention is, the compound of tallow, plumbago and charcoal, herein specified, substantially in the manner and for the purposes herein set forth."

25. For an *Improvement in Knitting Looms;* John Mee, Assignor to John Mee and John Rourke, Lowell, Massachusetts, and Gilbert Mackennon, Portsmouth, New Hampshire.

Claim.—"I do not herein claim the improved manufacture of ribbed fabric, made by two sets of warp threads; but what I do claim as my invention is, the two sets of thread guides, in combination with the two sets of needles, (or their equivalents,) and machinery for casting the loops, the whole being made to operate together, substantially as herein before specified; not meaning to claim the invention of a single set of thread guides, in combination with two sets of needles, and machinery for casting the loops, as such is not new; but meaning to claim the invention of two sets of thread guides, in combination with two sets of needles and machinery for casting the loops, all substantially as described, and operating together, to produce a ribbed knit fabric, such as I have explained. I also claim the improvement of causing the two sets of needles to work, or move up and down, independently of each other, or in other words, so that one set may move downwards, or be moved out of the way of the thread guides, to be brought into operation on the other set; such improvement enabling me to bring or arrange the two sets of needles close together, and thus make closer work than can be produced when the two sets of needles are made to move in one direction (either up or down) at the same time."

26. For an *Improvement in Warp Net Fabrics;* John Mee, Assignor to John Mee and John Rourke, Lowell, Massachusetts, and Gilbert Mackennon Portsmouth, New Hampshire.

Claim.—"What I claim as my invention is, the above described new or improved manufacture of warp knit ribbed fabric, the same being made by means of two sets of hooks or needles, and two sets of warps or warp yarns, laid and looped together, and upon the said hooks or needles, substantially in the manner as herein before specified, and whether to exhibit ribs, to equal or unequal widths, on opposite sides of the fabric, as explained."

27. For an *Improvement in Tonguing and Grooving and Moulding Cutters;* James M. Patton and William F. Fergus, Assignor to John C. Da Costa, Philadelphia, Pennsylvania.

"The nature of my invention consists in arranging series of cutting teeth, for forming a tongue, groove, or moulding on the periphery of a generally elliptical plate, inclined to the axis of its rotation, so that, as the said plate is rotated, the cutting teeth upon its periphery shall correspond, in reverse, to the tongue, groove, or moulding, to be formed thereby."

Claim.—"What we claim as our invention is, arranging the cutting teeth on the periphery of a plate, inclined to the axis of its rotation, so that as they are rotated, they shall correspond, in reverse, to the tongue and groove or moulding, to be formed thereby, in the manner substantially as herein described."

28. For an *Improvement in Printing Presses;* James Young, Assignor to John W. Middleton, Philadelphia, Pennsylvania; ante-dated November 10, 1852.

"My invention consists in the construction and arrangement of the various parts of a printing press, so as to execute the work with facility, while the greatest simplicity of construction is maintained, and the whole is quite under the management of the pressman; the especial points of novelty are the making and the mode of throwing off the impression, the nippers and nipper frame, the false bed and its accessories, the mode of working the rollers, and the mode of fastening the frame to the bed."

Claim.—"Having thus fully described my improvements in printing presses, what I claim is, 1st. the combination and arrangement of mechanism for operating the inking rollers, as herein described. 2d, I claim a false bed, hinged to a stationary one, and the mode of fastening the form to the bed, as described. 3d, I claim the eccentric, in combination with the platen, by means of which, the latter can be adjusted while in motion, or thrown off, substantially in the manner and for the purpose specified."

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, May 19, 1853.

George W. Conárroe, Esq., President, pro tem.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Society of London, and L'Ecolé Impériale des Mines, Paris.

Donations to the Library were received from The Royal Astronomical Society of London; L'Ecolé Impériale des Mines, Paris; W. J. McAlpine, Esq., Albany, New York; The Metropolitan Mechanics' Institute, Washington City, D. C., and from Messrs. Theophilus Code, Prof. John F. Frazer, George Harding, Charles E. Smith, and Dr. J. S. Sellers, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of April.

The Board of Managers and Standing Committees reported their minutes.

The Board of Managers reported their action in abolishing the School of Design for Women, in accordance with the recommendation of the following report of the Committee on the School:—

To the Board of Managers, Franklin Institute:

Gentlemen:—The Committee on the School of Design for Women, report, that circumstances have arisen, which in the judgment of the Committee, render it expedient for the Board of Managers to abolish the School of Design for Women, which has been placed under their charge.

The Committee have labored with great earnestness to render this branch of the Institute worthy of it, but have been thwarted by *internal* dissensions in the School, which paralyzed their efforts and destroyed its usefulness.

Believing the School had attained that permanency which would warrant a call on their fellow citizens for a sum sufficient for a permanent endowment, an effort was made to obtain it, and the sum of seventeen thousand dollars, or nearly half the proposed amount, was subscribed, when difficulties of so serious a character took place, that the effort was suspended. The subscriptions were conditioned upon success in obtaining the whole amount asked for, and are of course not available for the purpose intended.

The Committee made every effort in their power to heal the troubles in the School, and would have succeeded if they had been unanimous in their views; but unfortunately the lady through whose exertions the School was first instituted, took a view of the subject adverse to that taken by the rest of the Committee, and it soon became manifest that the success of the School depended upon a reorganization of the Committee, dispensing with her assistance, or an abandonment of the School to her and her friends. With this view an offer was made to Mrs. Peter verbally, that if she could organize an Association satisfactory to the Committee, they would recommend to the Institute a transfer of the School and the property accumulated for its use. This offer was at first declined, but afterwards the suggestion was renewed by that lady, and acceded to by the Committee.

A number of highly respectable gentlemen having, at the instance of Mrs. Peter, associated for the purpose, and having made themselves responsible by a written agreement, to assume all the contracts, liabilities and engagements of the Committee and the Institute, the Committee now recommend that the School of Design for Women, of the Franklin Institute, be abolished, and the existing property transferred to them. To this end the Committee offer the subjoined resolutions to the consideration of the Board.

In the course pursued, the Committee have been governed by the consideration that the School having originated with Mrs. Peter, it was due to her, to give her the opportunity to carry out her own views and purposes to the end, through such means as she might deem expedient; otherwise, reflections might be cast on them for having assumed an institution the credit of which was due to another. Under other circumstances they would, at an earlier day, have proposed a re-organization of their body, and would have assumed the respoosibility of the Institution.

It is due to the teachers of the Industrial Classes, to bear testimony to their unceasing efforts to develope the plans of the Committee, and the usefulness of the Institution, as well as to their entire propriety of deportment; and to the pupils for the assiduity and talent they evinced, by which they had already given conclusive evidence that the establishment of the School would have been a vast public benefit.

The success of the Drawing School was necessarily more varied, but many of the pupils have already attained so high a degree of excellence as to make their success in the designing room certain.

It is much to be regretted that, both teachers and pupils in the Industrial rooms, and several of the pupils in the Drawing School, have expressed their determination to withdraw under the new organization, but it is expected that the teachers will make such arrangements as will render the acquirements of most of the pupils available to themselves and the public.

It cannot be doubted, however, that the public spirited gentlemen who have assumed the responsibility of the Institution, will soon restore it to vigor and usefulness.

All of which is respectfully submitted by

S. V. MERRICK,
F. FRALEY,
DAVID S. BROWN,
CHARLES E. SMITH,
Committee.

HALL FRANKLIN INSTITUTE, }
Philadelphia, April 20th, 1853. }

Resolved, That the School of Design for Women, of the Franklin Institute, be and is hereby abolished, and that the Committee are authorized to transfer all the property appertaining to the School to Messrs. Job R. Tyson, Charles Gibbons, P. P. Morris, John Grigg, William D. Kelley, René Guillou, and William H. Bacon, under the provisions of contract signed by said parties, April 23, 1853.

Resolved, That the Committee be instructed to notify the liberal citizens who so generously subscribed to the Endowment Fund, that all claims of the Franklin Institute on them in consequence of said subscription, have ceased, and to return them the thanks of the Franklin Institute for their liberality.

Resolved, That the thanks of the Board of Managers be returned to Mr. Thomas W. Braidwood, Teacher of the Designing Class; Mr. Charles E. Maas, Teacher of the Woo Engraving Class; Miss Esther H. Hayhurst, Teacher of the Block Cutting Class; an

Miss Hannah L. Oakford, Temporary Teacher of the Drawing School; and to the Pupils under their charge for the zeal and assiduity displayed in their several spheres and duties, and for their correct moral and professional deportment, and the earnest desire evinced by all for the success of their several departments in the School.

Resolved, That the Minute Book and all papers appertaining to the School of Design, shall be placed by the Actuary among the Archives of the Institute.

New candidates for membership in the Institute (3) were proposed, and the candidates (6) proposed at the last meeting were duly elected.

Dr. Rand exhibited a Russian sleigh runner, brought by Joseph Harrison, Jr., Esq. It is of iron, grooved in the under surface, so as to be less liable to sink into light snow. There is a bridge upon it, in which is a socket or box, so that by taking the wheels off of an ordinary carriage, and inserting the journal part of the axle into one of these boxes on each side, the carriage is converted into a sleigh. Dr. R. remarked that a similar contrivance would no doubt be of service to our fire companies, whose efforts to reach a fire are often much embarrassed by newly fallen snow.

Dr. Rand further exhibited J. L. Gatchell's lightning rod. The point is of copper, gilded, and terminates in a platinum point. It is surrounded by a number of pointed copper rods, the whole being inserted into a zinc ball, which is screwed on top of the ordinary iron conductor.

Dr. Rand also presented Mr. Jason A. Mahan's apparatus for an improved stereotype process. This improvement consists in the employment of a caster, made of iron or other material, to be used instead of the common dipping pan. The caster is composed of several parts, and so constructed as to receive the moulds in a vertical position, or nearly so, with the face of one towards the back of another, by which method any number of plates can be cast at the same operation.

Mr. Mahan claims important advantages from his process, among which are, that the moulds may be as thin as it is possible to make them, for as they are placed vertically in the mould, they are not liable to be broken in the operation of casting; this thinness insures a rapidity in drying the mould. Also, that the amount of metal employed in casting need be but from one-fiftieth to one one-hundredth of the amount used in the ordinary process, thus saving in fuel and avoiding loss by oxidation. Dr. R. remarked that Mr. Mahan's invention was at present under consideration by the Committee on Science and the Arts.

Mr. J. Steinert exhibited Pulvermacher's voltaic chains and the accompanying apparatus, for producing an interrupted current. These chains form a very portable and convenient apparatus for the instantaneous development of a galvanic current. They require merely to be moistened with weak vinegar to produce a current of sufficient power to decom-

the increasing [illegible] requiring protection.

The present Steam Navy of the United States comprises,

2 First class vessels, *Susquehanna*, *Powhatan.*
3 Second " " *Mississippi*, *Saranac*, *San Jacinto.*
4 Third " " *Princeton*, *Alleghany*, *Fulton*, and *Massachusetts.*
4 Smaller " *Vixen*, *Michigan*, *Water Witch*, and *John Hancock.*
2 Tugs.

The last six of which are too insignificant to be classed as war steamers, none of them exceeding four hundred tons measurement. In addiwhich is to render the graduations of the scale more uniform. The ordinary closed top gauge is open to the objection that from its uniform diameter the graduations became smaller as the pressure is higher; while for convenience in practice the indications should be more distinct under high pressure. This object is attained by the form given by Mr. Grimes to his tubes. The gauge for showing the water level in the boiler consisted of an arrangement similar to that of a barometer, the cup communicating with the boiler by a tube entering at a point just above the water level, and kept by condensation constantly full of water. The inner tube was connected also with the boiler by a pipe entering below the lowest water level; consequently, by suitable graduation of mercury in the cup and tube, so that it should stand at the same height at the lowest water level in the boiler consistent with safety, the rise of water above this point would be indicated in the gauge by the rise of the inner column; and in general terms any alteration of level in the boiler would be distinctly indicated in the gauge by a corresponding rise or fall, equivalent to about one-thirteenth the alteration in the boiler. The action of the gauge of course depended on the different weights of the column of water in the two pipes, and was entirely independent of the direction taken by the pipes, their length, or the relative heights of the boiler and gauge.

[This instrument is already applied in several places in the vicinity, and is understood to operate well; while its form, and the ingenuity displayed in its construction, were generally admired by members present.]

Mr. J. V. Merrick exhibited one of "Ashcroft's" steam gauges, constructed on Bourdon's Patent, and depending for its operation on the expansion in diameter of a coiled tube subjected to internal pressure. In these gauges the pressure tube was flat and occupied a single coil, one end being fastened, and communicating internally with a pipe leading to the boiler or other vessel in which pressure was maintained; while the other end was connected by a simple contrivance to a shaft carrying an index hand, which vibrated on the graduated dial plate of the instrument. The pipe leading to the boiler being bent in a syphon form, was always kept full of water, so that the coil was not affected by the high temperature of the steam. He stated that vacuum gauges had been constructed on the same system, and referred members for a more particular description of this instrument, and its various applications, to the accounts published in the *Journal of the Institute*, vol. XXII., new series, p. 234.

COMMITTEE ON SCIENCE AND THE ARTS.

Resolved, That the School of Design for Women, of the Franklin Institute, be and is hereby abolished, and that the Committee are authorized to transfer all the property appertaining to the School to Messrs. Job R. Tyson, Charles Gibbons, P. P. Morris, John Grigg, William D. Kelley, René Guillou, and William H. Bacon, under the provisions of contract signed by said parties, April 23, 1853.

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BIBLIOGRAPHICAL NOTICES.

The Naval and Mail Steamers of the United States. By CHAS. B. STUART, Eng. in Chief, U. S. Navy: New York, Chas. B. Norton.

This work forms the second of a series on the enginering works of this country, announced some months since by the same author in the volumes descriptive of the Naval Dry Docks of the United States.

In point of execution, it is without doubt the most splendid engineering work ever published in America, and gives evidence that neither pains nor expense have been spared to produce a model worthy of imitation in future productions of the same character. It is printed in clear type on beautiful paper, and illustrated with several steel plates and tinted lithographs of naval steamers, interesting to the general reader, besides scale drawings of the engines of the *Arctic*, *Illinois*, *Golden Gate*, &c., which will be duly appreciated by engineers. The letter press is divided into two parts; the first containing detailed accounts of each steamer in the Navy, particulars of size, cost, weight, and in some cases, performance at sea. The second part gives similar information regarding those steamers in the merchant marine, which have been built for mail service and under special stipulation with government, with a view to their conversion into war vessels in case of urgency.

In reviewing the first part, one cannot fail to observe the repeated "editions" (so to speak) of the same vessels, which have from time to time belonged to the navy; as for instance, three *Fultons*, two each of the *Alleghany*, *Princeton*, *Water Witch*, *John Hancock*, *&c.* This peculiarity appears to have arisen from the deficiencies of the service, which, from want of special appropriation by Congress, have been supplied, not by new vessels, as they should have been, but by rebuilding or patching and altering old ones. As these were in many instances useless at first, they have been only rendered seaworthy by an expenditure which would have produced larger and more efficient ships, embodying improvements introduced of late years on the ocean. Such a course was perhaps the best which could have been adopted under the circumstances; but every American feeling a just pride in this department of the national defences must regret the result.

Our Steam Navy, as will be seen by the following statistics gathered from the work before us, compares very unfavorably, in point of numbers at least, with those of other nations; while it is certainly inadequate to the increasing wants of our commerce or the extended line of seaboard requiring protection.

The present Steam Navy of the United States comprises,

2 First class vessels, *Susquehanna*, *Powhatan.*
3 Second " " *Mississippi*, *Saranac*, *San Jacinto.*
4 Third " " *Princeton*, *Alleghany*, *Fulton*, and *Massachusetts.*
4 Smaller " *Vixen*, *Michigan*, *Water Witch*, and *John Hancock.*
2 Tugs.

The last six of which are too insignificant to be classed as war steamers, none of them exceeding four hundred tons measurement. In addition to the above, the provisions of the mail contracts entitle government to the services of the four Collins steamers, *Atlantic*, *Pacific*, *Arctic*, and *Baltic;* three of the Law line, *Illinois*, *Ohio*, and *Georgia;* two in the Bremen line, *Washington* and *Hermann;* two in the Havre line, *Humboldt* and *Franklin;* and two in the Aspinwall line, *Golden Gate* and *John L. Stephens*.

The details of these mail steamers, which Mr. Stuart appears to have collated with considerable care, are very valuable additions to the engineering literature of the country. We notice particularly in this connexion the specifications of Collins vessels, hulls and engines, and the drawings of the machinery of those and other ships.

In many points of view, the work before us deserves more than a passing notice. It is rarely that a book issues from the press in this or any other country, of which the *mechanical* part is so well performed; and as the library of American works on engineering is not extensive, any additions to it are welcome. The information it contains is probably as reliable as such works can be made; the author, from his position, having had every facility in preparing it; and without much pretension to originality, or theoretical discussion, (both of which are uncalled for in a work of similar character,) it contains many facts of real value, and interesting to the mechanical engineer. Finally, it must be conceded that the author has shown a praiseworthy zeal in awarding credit to the individuals who have in any way lightened his labor, or who by their skill and ingenuity have contributed to the construction of the navy of which he has constituted himself the historian.

On a New Variety of Asphalte, (*Melan-Asphalte.*) By CHARLES M. WETHERILL, M. D. (Extract from the Transactions of the American Philosophical Society.)

The substance which forms the subject of Dr. Wetherill's paper is the one about the nature of which a legal dispute arose a few years ago, in the course of which many American men of science were examined, with a result very little to the credit of the science of this country. The question was, whether it was an asphalte or a coal. In the course of the trial Dr. Wetherill was called upon to make a chemical investigation of the material, and the results at which he arrived are given in the paper before us. The result at which he arrived was that the substance was an asphalte, very much resembling the common asphalte, both in appearance and chemical and physical reactions, and (within quite allowable limits) of composition. In all these differing vastly from coal. In this result he agrees with Dr. Leidy, the late Mr. Taylor, and other competent, careful, and honest observers. We believe there is now a disposition to class the body as a new mineral under the name of Albertite; but if there be any law in scientific nomenclature, the name of Dr. Wetherill, who was the first to propose a name, must stand, and the substance must be called Melan-asphalte. For unless Dr. W. is very widely mistaken in his results, (and we do not see how he can be,) the body evidently belongs to that class of substances which it so much resembles in its appearance.

F.

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